SCIENCE

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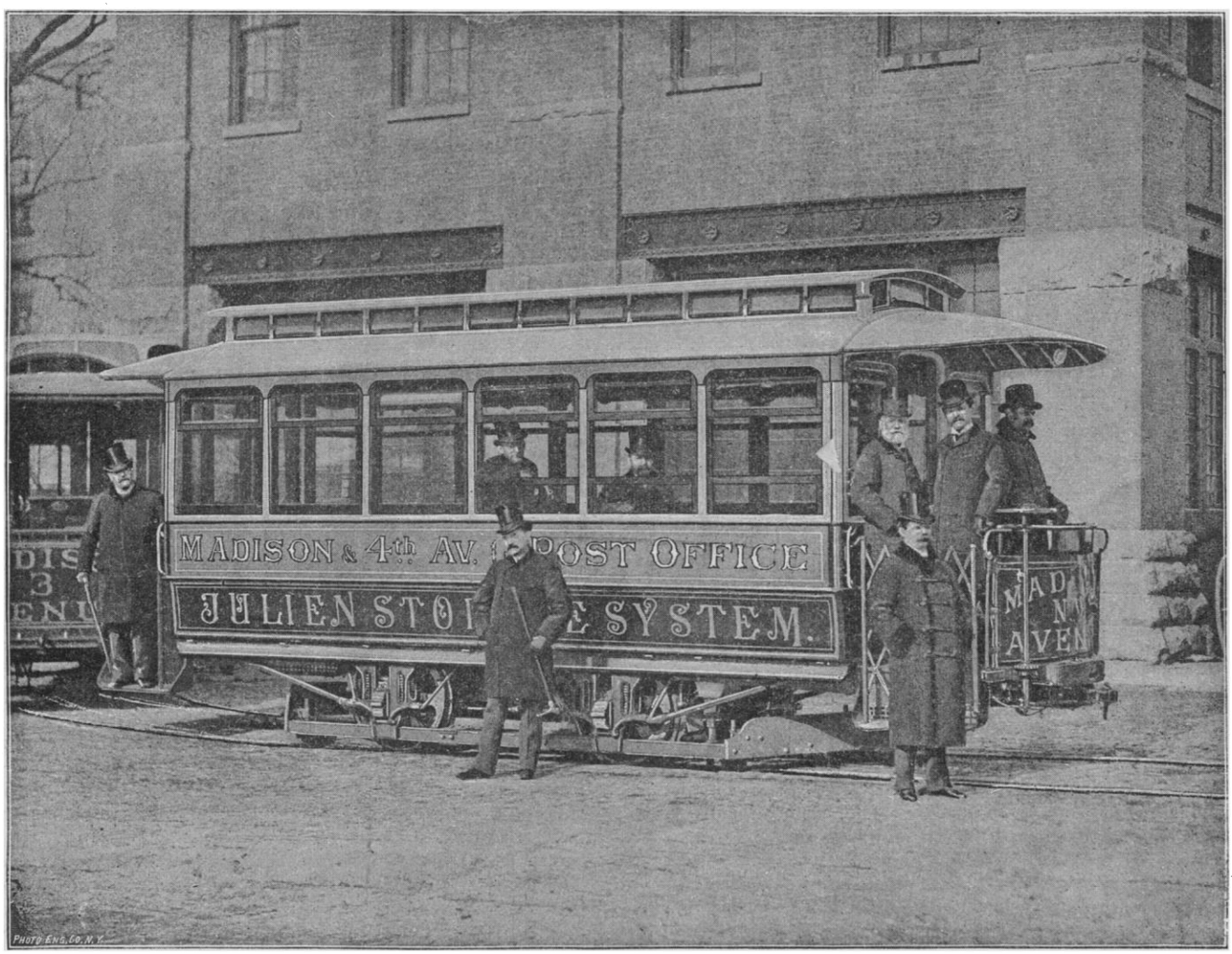
STORAGE-BATTERIES FOR STREET-CARS.

THE last car which the Julien Electric Traction Company put into actual passenger service (Car No. 7), and which is the standard type of car that they have finally adopted, is making five round trips per day between 86th Street and Madison Avenue and the Post Office, or 57½ miles daily. This is a car-day's work on that line. They claim a saving per year in favor of the Julien system, on each car, as compared with horse-cars, of $2,719.25, and that the net earnings will more than pay the entire cost of the car and its equipment at the end of the first year. During the time (forty days) the car has been in operation, neither the batteries nor the motors have required attention or the expenditure of one dollar for repairs or renewals. Even the brushes, it is claimed, have not been changed, nor do they show any wear.

Car No. 1, on the Fourth Avenue line, commenced service on Sept. 3, and on April 8 the batteries were examined for the first time. They had not in this period been lifted from the cells to be cleaned or inspected. It is claimed that they were found to be in as good condition as when they were put in service; not a single plate in the whole battery showing any wear, injury, or depreciation.

At one time it was thought that the handling of the batteries in this system of traction would be a serious obstacle; but this company has now a battery-shifting device, whereby, in the length of a car-body, and on either side of the pit over which the car stands in the station, sufficient batteries are stored and manipulated to do the work of one hundred and thirty-five horses. The racks which contain the batteries, and the hoists, which are run by two small stationary motors, do not, in all, cover as many cubic feet as two



STREET-CAR DRIVEN BY JULIEN STORAGE-BATTERIES.

sixteen-foot cars. By aid of this device the batteries are changed in less than three minutes. In actual time, less than five minutes are required to inspect the car thoroughly and change the battery.

A feature of this system is, that a street-railway need no longer have its own generating machinery, as must be the case with cables, overhead wires, and conduit systems. In every town and city where there is a central lighting-station, power for charging the batteries, it is stated, may be purchased for about two cents per horse-power; so that the plant of the system will be reduced to the devices of one battery-rack, as above described, for each set of fifteen cars, and switch-boards for governing the distribution of the current.

The cost of motive power for a car-day of 60 miles, the company estimate at $3.10. By motive power, they mean cost of energy at two cents per horse-power, and $700 per annum for maintenance of batteries and motor. These figures, they claim, are the result of their present experience. To those who may think two cents per horse-power a low estimate, they say that they have offers from electric companies to furnish power at that figure.

The new cars, thirty of which are now under construction by the Stephenson Company, will weigh but a fraction over six tons; or, in other words, but little more than the cars of the overhead system.

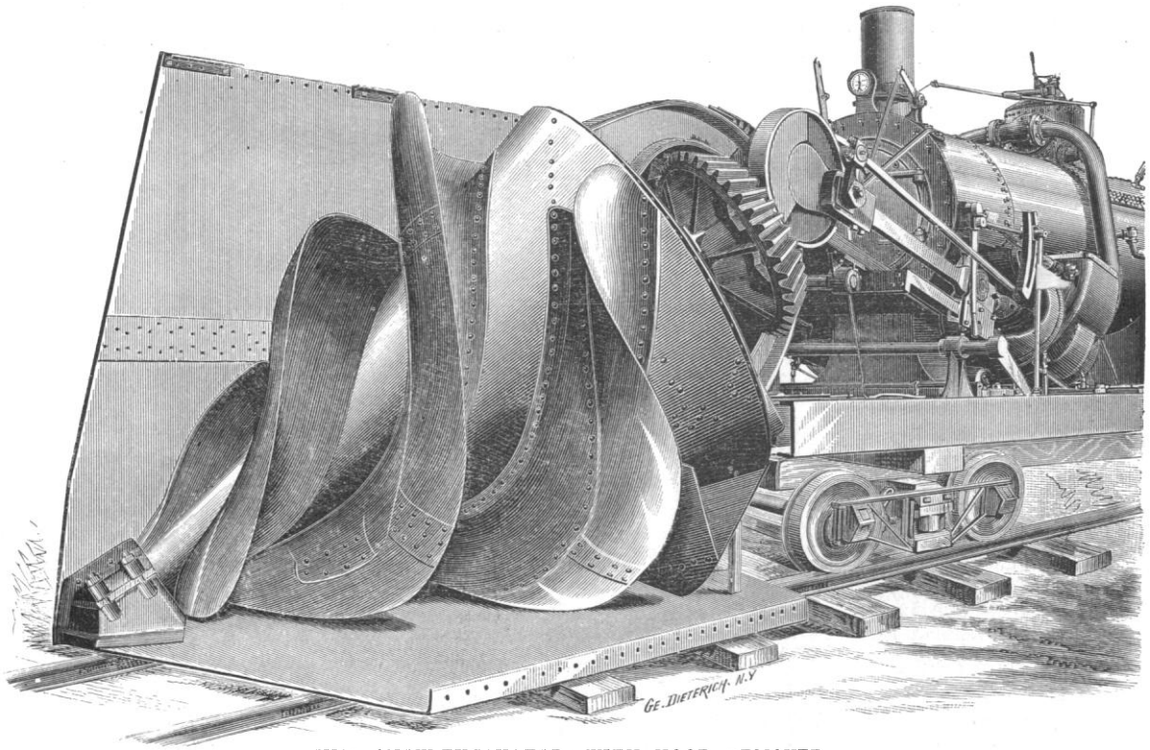
IVORY VARNISH.

A NEW medium for protecting glass negatives and positives from injury by dampness, friction, or moist printing-paper, has recently been introduced under the name of "ivory varnish," according to *The Photographic Times;* and, so far as experiments with it have progressed, it seems to be an excellent and safe compound. As it dissolves pyroxiline, however, it cannot be used for collodion plates; but it is perfectly applicable to gelatine negatives. The latter need not even be heated when the varnish is applied, but the preparation is merely flowed over their surface and dried in an ordinary temperature. The result is a protective film of extreme hardness, which perfectly resists the action of all moisture. A negative thus varnished, after being thoroughly dried, may be immersed in hot water of 120° F., and wiped dry with a rag, without injury. This quality makes the "ivory varnish" an excellent one for transferred bromide prints. The damar varnish heretofore used for this purpose, being softened by a high temperature, will scratch or dull when touched. The varnish is mainly intended, of course, for "ivory" film negatives, and for this purpose nothing can be better. It will not crack or soften; dust, water, and foreign matter will not adhere to it; and retouching is facilitated by its use.

THE JULL SNOW-EXCAVATOR.

IN December last the Jull Snow-Excavator Company sent out a preliminary circular, calling the attention of railroad officials to the fact that its snow-excavator was in course of construction, under recent patents of Mr. Orange Jull of Ontario, Canada. Since then the excavator has been completed, and submitted to three severe tests on the Rome, Watertown, and Ogdensburg Railroad at Oswego, N.Y.

On March 6, 1889, the excavator cleared seven hundred and fifty feet of track, covered with hard frozen snow varying in depth from two to seven feet. The snow was thrown a distance of sixty feet. This was a particularly severe test, by reason of the fact that the snow had been lying upon the siding during the entire winter, and



JULL SNOW-EXCAVATOR, WITH HOOD REMOVED.

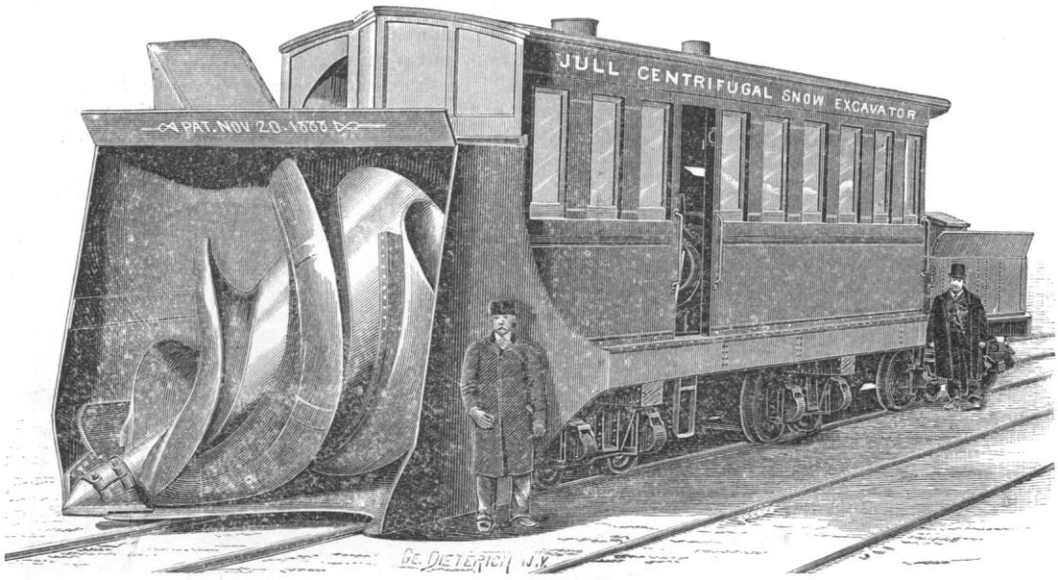
was nearly as hard as solid ice. Some of the pieces of ice thrown out were afterwards weighed, and one was found which weighed seventy-five pounds.

On March 9, 1889, the excavator cleared a siding upward of nine hundred feet in length, filled with hard snow varying in depth from two to eight feet. The time consumed was not taken on either of the above occasions; but the excavator worked steadily, and without any stoppage whatever.

On March 11, 1889, the third exhibition was made at Oswego. This demonstration was witnessed by representatives of the Rome, Watertown, and Ogdensburg Railroad, the Lehigh Valley Railroad, and the Pennsylvania Railroad. In this case the excavator was timed, and exact measurements taken, by the railroad officials present, of the length of the cut, and depth of snow. The length of the cut was 720 feet; average depth of snow, 7 feet, varying in depth from 18 inches to 10 feet or more; the width of space cleared was 10 feet. This cut was cleared of snow, and the rails left clean, without the use of flangers, in seven minutes time. The motive power was furnished by two passenger-locomotives, one with a cylinder 16 by 22, and the other 17 by 24. The number of revolutions of the bladed cone did not exceed 180 per minute, although its capacity exceeds 300 revolutions per minute. Thus it

will be observed that there were cleared in seven minutes, 50,400 cubic feet of snow, or 7,300 cubic feet per minute. It was estimated by one of the railroad officials present that it would have taken 100 men an entire day to accomplish what was done in seven minutes.

The accompanying illustrations, taken from photographs, show the cardinal principles of the device, yet a brief mention of some of its distinctive features may not be out of place.



JULL SNOW-EXCAVATOR.

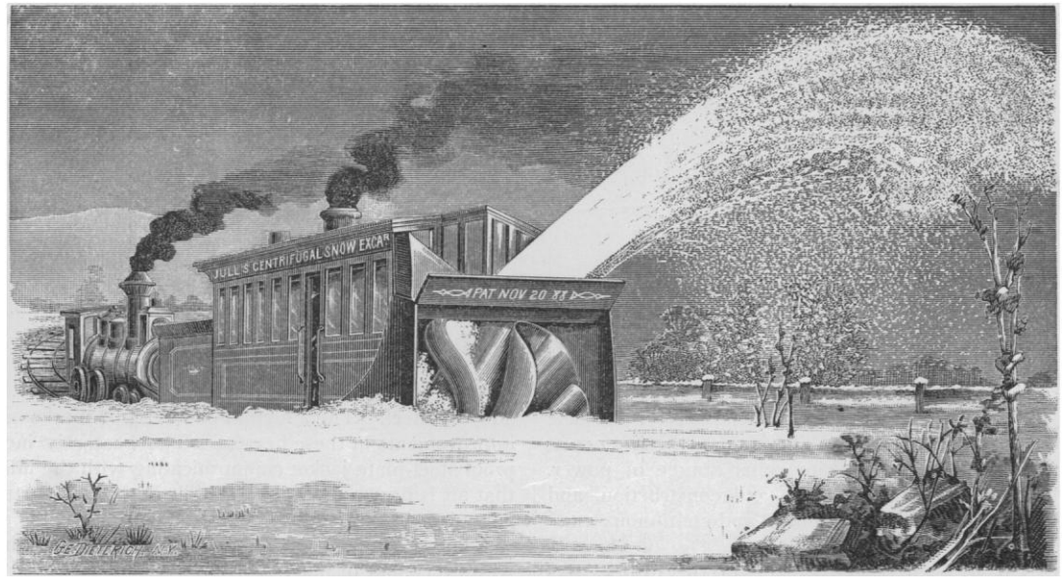
1. The diagonal arrangement of the bladed cone, so that its apex is at the lower right-hand corner of the hood, while the base is at the upper left-hand corner, is one of its distinctive and important features. By this arrangement the curved blades of the cone operate directly upon and slice off the face of the snow-bank, from side to side of the hood, without any direct resistance whatsoever, except that of the straight sides of the hood.

2. The curvature of the blades is much greater toward the apex of the cone than toward its base, so that in their first contact with the snow the blades operate as an augur. As the velocity of the cone in its revolutions increases toward its base, by reason of its increasing diameter, the centrifugal force generated is correspondingly increased; so that the snow gathered in by the curved blades is thrown out without the necessity of fan-blades, other than the blades of the cone itself. Thus the snow is sliced off and discharged in one operation, by means of a single mechanism, the absolute simplicity of which is considered a valuable feature.

3. It is impossible, the company claims, to choke the hood or blades of the cone with snow. It always comes out of the snow absolutely clean, with its blades free from snow.

4. The power to operate the bladed cone is supplied by an 800-horse-power boiler, containing 220 2-inch flues. The engines consist of two 18 by 24 cylinders.

5. The snow may be thrown to either or both sides of the track without reversing, and, in fact, changed from one to the other without stopping. To quote from the *Engineering News* of March 30, 1889, "there is no double direction of revolution, no reversion of knives, and no closed box to hold snow, back of the mechanism which first attacks it."



JULL SNOW-EXCAVATOR IN OPERATION.

The Jull Manufacturing Company (Brooklyn, N.Y.), of which Mr. George H. Hobart is president, solicit an investigation concerning the merits of their excavator, and state that the centrifugal excavator is also adapted to clear railroad-tracks which have been blockaded by sand.

IMPROVED STEAM APPARATUS FOR HEATING AND VENTILATING.

THE house of B. F. Sturtevant, Boston, Mass., has just brought out a new design of its steam hot-blast apparatus, which is now well known. This apparatus, first placed upon the market a quarter of a century ago, has been gradually improved and rapidly introduced, until about 5,500 are now in use for various purposes.

The apparatus is a practical embodiment of the principle that a positive circulation of air is necessary to secure rapid and perfect ventilation, heating, or drying. Although constructed in a great variety of styles, to suit all conditions and requirements, it always combines the essential elements, — a fan and a heater. It is furthermore usually constructed with an engine directly connected to the fan-shaft, as shown in Fig. 1. The fan is designed especially for handling large volumes of air with a minimum expenditure of power. The advantage of a special engine, for the sole purpose of driving the fan, is evident. The fan may then be run at any time and speed, independent of any other source of power. The engines are of Mr. Sturtevant's design and construction, and are equal to the trying duty of fan-propulsion and continuous running.

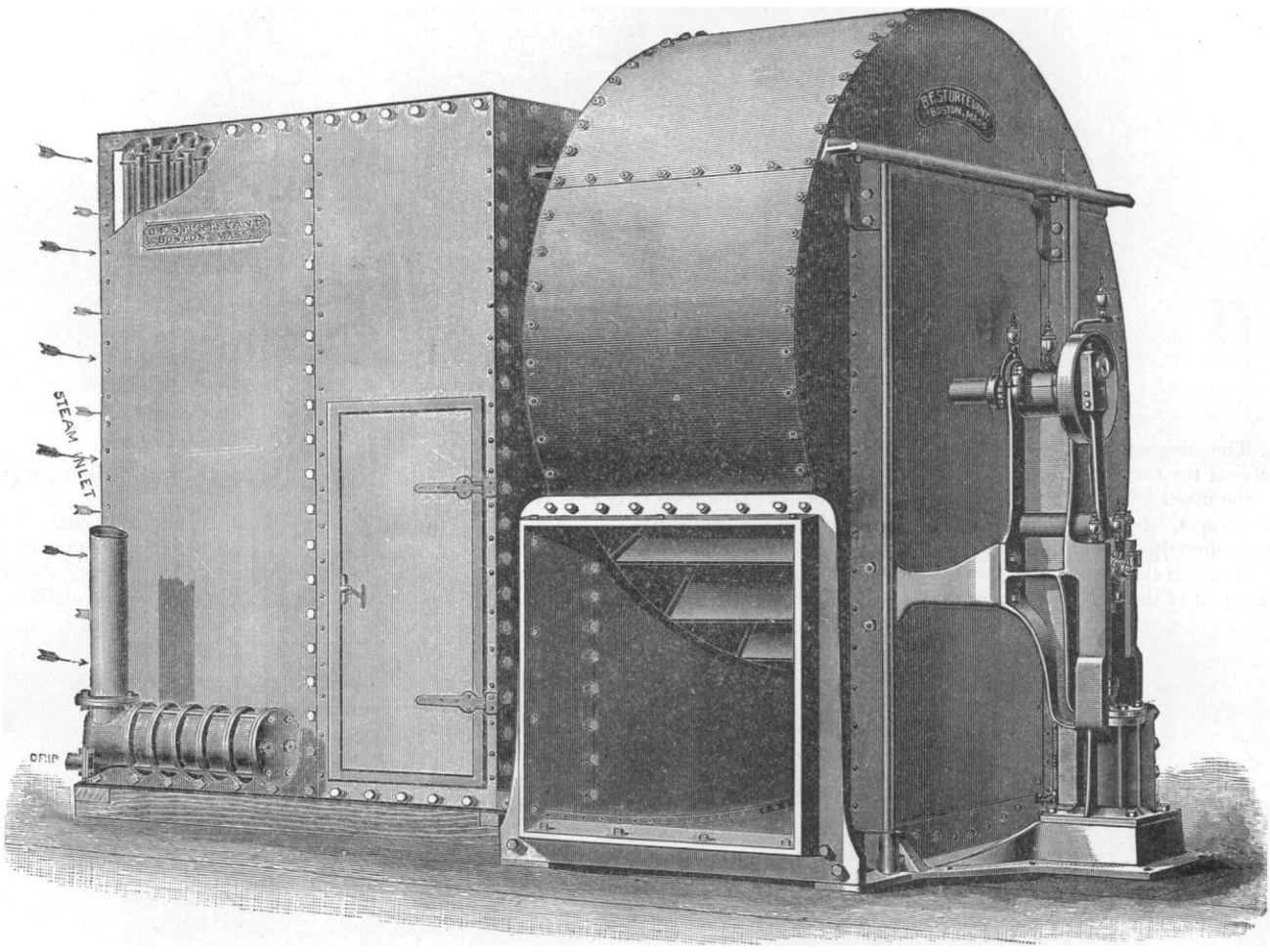


FIG. 1.

Radical changes have been recently made in the heater. As now constructed, the heater proper consists of a series of hollow sectional bases, shown clearly in Figs. 2 and 3. Their sides are corrugated so as to fit closely together and allow of no alternate expansion and contraction of the air passing between the pipes. At one end of each section is a circular head (see Fig. 2) divided horizontally by a diaphragm, so that the upper portion is in communication with the steam inlet, and the lower with the drip. Steam, admitted at the left through the steam inlet, passes up the series of pipes, through the horizontal pipes, and down into the space connecting with the drips. By this time it has condensed, and leaves the heater in the form of water of condensation.

The sides of these heads are planed and fitted, and joints made by copper gaskets; so that, when drawn together by the through bolts, there is no possibility of leakage. In connection with the sections is bolted on, at one end of the group, a header for steam inlet (*A*), and drip (*B*). Both of these are large, and allow of the use of exhaust steam without placing back pressure upon the engine. The pipes *C* and *D* are respectively exhaust-steam inlet and drip, communicating with the outermost section, which has no head, and is entirely independent of the remainder of the group. It is designed to utilize the exhaust from the fan-engine. The head end of each section rests upon the wrought-angle-iron foundation of the heater, while the opposite ends are supported by cast-iron balls (*E*) so as to allow for expansion.

After continued use of wrought-iron pipe, Mr. Sturtevant has adopted steel. The adoption of steel pipe marks one of the great improvements in these heaters. The heater is incased in a fire-proof steel-plate jacket communicating with the inlet to the fan, so that air is drawn by the fan equally across all parts of the heater. The pipes in the sections being set staggering, the air is compelled to take a tortuous course, and is brought into intimate contact with every foot of pipe.

In operation for heating and ventilating, the outlet of the fan is connected with a system of ducts or pipes leading to the various parts of the building. In the case of an ordinary manufactory either the distribution takes place through galvanized-iron piping, in the form of upright mains extending to the various floors, and having one or more outlets near the ceiling on each floor, or in other cases horizontal mains extend the entire length of the building just under the ceiling on each floor, and the air is discharged through outlets in these. In schoolhouses, churches, theatres, etc.

the air is generally conveyed through flues built into the interior walls; the volume and rate of discharge being governed by the register through which the air escapes.

The object always is to discharge the air either at or towards the cold outer wall, but it must be admitted that it takes a great deal of experience in this line to enable any one to lay out a perfect working system.

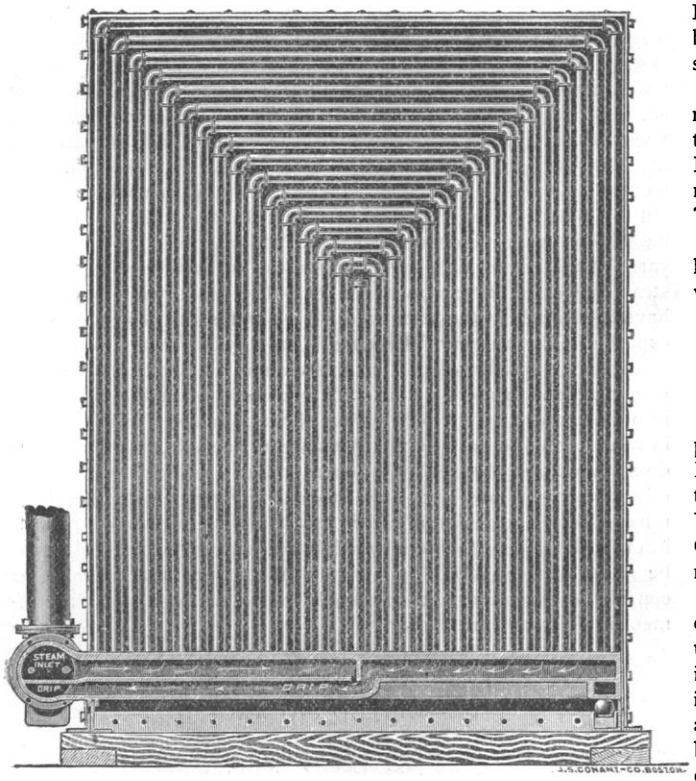


FIG. 2.

This system, known as the "blower system," possesses many advantages. Above all, it is positive. The air, being forced into the building, must of necessity thoroughly circulate through it, creating perfect distribution of heat, and ample ventilation. The source of supply of the air introduced being always under control, there can be no opportunity for the presence of injurious impurities. In any system dependent upon natural agencies to produce ventilation, changes in the weather always have a serious, and in some cases a perfectly nullifying effect. With mechanical ventilation, this can never occur, for the pressure produced by the fan is far in excess of that due to any changes in the atmosphere.

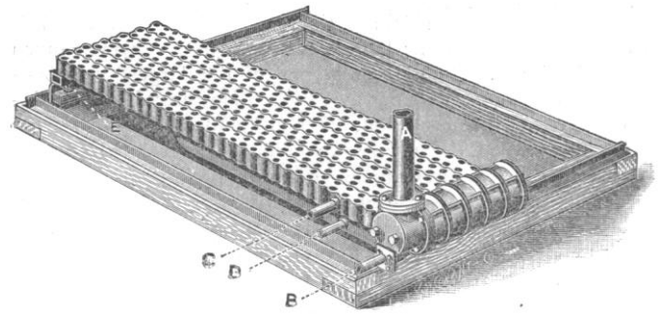


FIG. 3.

In the blower system, a marked saving is made in the amount of heating-surface required. The large amount of air passing through the heater causes such a rapid condensation of steam, that each square foot condenses from three to five times as much steam as will be condensed by the same area in an ordinary coil-radiator; in other words, only one-third to one-fifth the pipe is required to do the same amount of heating. The saving in the heating-surface will usually pay for the fan and engine, so that the system becomes no more expensive than a direct-heating system.

But while in a direct system there is always danger from fire, freezing, and leakage, this is all obviated in the blower system. All the pipe is combined in a single heater, incased in a fire-proof jacket, and all valves are within easy reach, placing the entire control of the apparatus in the hands of a single individual. Furthermore, a much more rapid change in the temperature of the building is possible with the blower system than with any other system, either direct or indirect.

Most assuredly the system is worthy of investigation by any one requiring either heat or ventilation. It is now in use in some of the largest manufactories in the country, such as the Pacific Mills, Lawrence, Mass.; the New O. N. T. Clark Thread Mill at Kearney, N.J.; the Morgan Engineering Company, Alliance, O.; Niles Tool Works, Hamilton, O., etc.

Mr. Sturtevant has recently issued a handsome eighty-page illustrated treatise on ventilation and heating, which we are informed will be sent to any one requesting it.

BRICK FOR STREET-PAVING.

THERE are perhaps fifty cities in the United States using brick pavements. Some have had them over fifteen years. In Decatur, Ill., brick pavements have been in use for six years; in Bloomington they have been used for fifteen years; and in Charleston, W.Va., for a longer time. They are in use in Jacksonville, Peoria, Quincy, and Springfield, Ill., also in Kansas and Nebraska; and a number of cities in Ohio are using them with good results.

All brick pavements have not given satisfaction, as the contrary effect has been produced when common building-brick has been used. They begin to show the effects of wear in a very short time if soft brick is used, but good hard brick gives satisfaction. There is no paving-material equal to hard brick, excepting granite blocks, and it is doubtful if they would last as long were they as small as bricks. There are few cities in the United States where brick could not be laid for one-third the cost of granite blocks.

It may be urged that suitable clay for manufacturing paving-brick is scarce, but there is nothing in this country so plentiful. Of over twenty different samples of clay sent from various portions of Illinois and other States to the Decatur Tile Company, all excepting one have been made into paving-brick, although some kinds are much better for the purpose than others. This company has made about five million bricks per year during the past four years, seventy-five per cent being paving-brick. Over five miles of the streets of Decatur are paved with brick, and the City Council is planning to have more of them thus paved.

The clay used by the tile company mentioned is a common yellow joint clay, having a large percentage of silicate and iron. It is tempered or soaked for twenty-four hours before using, then carried by a belt to a stone-separator and crushers. Dropping from the crushers to an elevator, it is fed to the brick-machine. From this machine it runs in three streams upon a moving table, and is cut by wires, fastened in a frame, into bricks eight and a half inches in length. The die through which the clay is pressed on leaving the machine is 4 by $2\frac{3}{8}$ inches. The bricks are then set upon drying-cars to be dried in hot-air tunnels, or set on slats in a building warmed by steam, or placed on a drying-floor heated from the burning kilns or small furnaces. When dry, they are carried in wheel-barrows and set "skintling," or at angles across each other, to allow the heat to pass between them in the down-draught kilns. Experience has proved that good paving-brick cannot be burned in open, up-draught kilns, if made from the clay described.

While some kinds of clay will stand fire long enough to burn as hard as rock in open kilns, yet even then the bricks would be much better in shape and quality if burned in closed kilns. The bricks are burned from six to seven days, the first three or four days very slowly, called "water smoking." It is necessary to watch very closely when finishing the burning, as there is great danger of running the bricks together and spoiling the whole mass.

The great drawback to using all kinds of clay is owing to the

gravel found in many clay banks. There are machines for separating the larger stones and crushing the smaller stones, which work very well excepting where there is limestone. The only remedy for that species of clay is washing, which is too expensive for common brick-making. A machine that will separate all gravel or other hard substances from the plastic clay, and leave it fine enough to be worked into terra-cotta, has been tested, and fulfils all the requirements. It is very simple, and will separate large quantities of clay with very little power. This machine will help manufacturers to use clays which at present are worthless, but which may become sources of wealth when passed through suitable machinery.

Some may smile at the idea of making bricks by machinery, but it is believed that brick-making by hand will soon become a thing of the past. The stiff-clay, machine-made brick will be used for paving purposes, bridges, docks, tunnels, and all works that require great strength; while dry-pressed brick will become the building-brick of the future.

Four specimen bricks made by the tile company mentioned, and picked up at random, were submitted to a test by the Chicago Forge and Belt Company about three years ago. The ultimate crushing resistances of the samples were 252,000, 228,000, 210,000, and 318,000 pounds respectively. The bricks measured $7\frac{1}{4}$ by $2\frac{1}{4}$ by 4 inches.

The construction of a brick pavement is a simple matter. The foundation being brought to the proper grade, there is spread over it six inches of gravel or sand, which is struck off with a board gauge fitted for the grade of the street. A course of brick is then laid on the flat surfaces, running lengthwise the street. It is not necessary that this course should be as hard as the upper course, being only a foundation for the brick that will receive the wear. Over this an inch of screened sand is spread, gauged, and properly smoothed off. The top course is laid with the bricks on their edges, lengthwise across the street. Care is taken to break joints in both courses. The whole is covered with an inch of screened sand, which is swept into the crevices. After this is done, a roller weighing five or six tons is passed over the pavement several times. If the street is properly rolled, it will be as smooth as wooden pavement, and almost as noiseless.

The street should be drained in some manner, as the lasting qualities of the brick and the even surface of the street depend to a great extent upon the drainage, as it is a well-known fact that water weakens brick very much. It would be a good plan to run a six-inch drain tile outside of the curbing, connected with a four-inch tile running through the curbing at the corner of each block. This will carry off all surface water; and, if the six-inch tile is about three feet below the surface, it will drain the sides of the street, so that water will not reach the foundation of the street.

The upper course should be very hard. The brick should be vitrified. It may be objected that if they are burnt to a glassy surface they will chip off or be crushed. That objection is not sustained. In Decatur are whole blocks paved with brick as smooth as glass and as hard as flint, and no brick of that description shows any signs of wear. The wear comes on the objects passing over the bricks, which are harder than steel, for a file will not scratch them: in fact, when broken open, they resemble flint.

Horses do not slip or fall on brick pavements as they do on granite blocks, owing to the small surface between the seams. Another advantage possessed by vitrified brick is that they will not soak water. If water and frost are kept out of brick, they are almost indestructible. Professor R. T. Brown says, "Clay well burned is as nearly a neutral substance as any in nature: its elements, being well united and in chemical equipoise, have no affinity for other substances that might disengage them from their combination. It is therefore chemically indestructible."

The Decatur Tile Company laid a block of brick four years ago, on a private contract, agreeing to make all repairs for five years free of charge. The street has not yet needed any repairs whatever, and from present appearances it will not be necessary to make any for the next twenty years. The first cost of such a pavement is low, the best pavement in Decatur costing only from $1.25 to $1.50 per square yard.

It was formerly thought that only certain kinds of clay could be used for paving-brick, and the Decatur Tile Company is believed to have been the first to make it of common clay. Now there are a number of factories using the same kinds of machinery, and making the same quality of brick from such clay.

The following, from the *Clay Worker*, is of interest in this connection: "Brick-making has been dormant for nearly thirty centuries. From the time that clay-workers moulded and burned the bricks for the Royal Palace of Nebuchadnezzar, and stamped the royal signet on them, till the beginning of the present century, not a single step had been taken toward improvement in any of the processes involved in making and burning brick. Within the last fifty years, however, brick-making has been waked to new life, and now scarcely one of the old processes in its original form remains. Every thing, from the selection of the clay, to its preparation, moulding, drying, and burning, is stamped with innovation, may we not say with improvement? Machinery has been called in to aid this march of progress; and what had been the drudgery of hard labor, from the days when the Israelites toiled in the brick-yards of the Rameses, is now thrown on the broad shoulders of steam-power." It may be added that the greater improvements have been made in the last seven years, and still greater may be expected. By bringing the fuel and clay together with proper appliances, we may have good, clean streets in all our cities. And it would pay the farmers well if brick pavement should be extended into the country, as it would enable them to market their produce in winter, when otherwise the roads are impassable. It would also do away with road-taxes for a generation at least, for a road properly paved with hard brick ought to last fifty years, with very little repair. For a road paved, fifteen feet wide, with two courses of brick, at the prices of material and labor already given, the cost would be about ten thousand dollars per mile. Such roads might be considered expensive, but they would prove to be a good investment in the long-run.

J. G. SHEA.

A FIVE-MASTED SAILING-SHIP.

THE preference of ship-owners for large cargo-carrying vessels is becoming more and more pronounced, and the companies more particularly engaged in the part of the shipping trade in which sailing-ships are worked seem to vie with each other in securing "the largest ship afloat." Intimation is given in *Engineering* that a contract has been placed with a firm on the Clyde, who make the building of sailing-ships a specialty, for the construction of a five-masted steel sailing-ship to carry 6,000 tons dead weight. Not only will this be the first five-master, but it will be the largest sailing-ship afloat. At present a vessel named "Liverpool" has this distinction. She has a gross tonnage of 3,330 tons, her length being 333 feet, breadth 47.9 feet, and depth 28 feet moulded. Brokers, too, like the big ship, and the reason is so evident that it is not necessary to refer to it; but underwriters do not seem so much enamored with it. Quite recently one of the largest vessels — shorter by 10 feet, but broader by $1\frac{1}{2}$ feet, than the "Liverpool" — was chartered to take coal; but, when all the debatable points of a charter were settled, the underwriters had to be reckoned on, and they desired such a premium as made it quite impossible to proceed further in the matter, — something like £10 to £15 per £100. They contended that the greater the quantity of coal carried, the greater the danger of fire. This vessel, however, has made several voyages, and no difficulty is now being experienced with the insurance firms. They will be educated to a higher standard, although at present a little conservative. There is another difficulty, however, which cannot be so readily overcome. Such large vessels can only be employed profitably in certain trades, and great inconvenience must arise unless suitable graving dock accommodation can be afforded at the large trading ports. No difficulty will be experienced at home; but in Calcutta, for instance, one of the big ships now afloat presented itself recently for admittance to the dock, and it was found that her beam was too great; and yet boats with more beam will be built. The result was that she had to load, and hope for better accommodation at her next port. San Francisco and New York have large docks, but the importance of Calcutta port for ships cannot be ignored.

ELECTRIC-LIGHTING STATIONS IN EUROPE, AND THEIR LESSONS.

PROFESSOR GEORGE FORBES read on Feb. 28, before the English Institute of Electrical Engineers, a paper with the above title, which gave the results of his inspection of the electric-lighting stations at Berlin, Rome, and Milan. He first described the Berlin central stations. There are three of these, using a direct-current, low-pressure system, and connecting with the same network of mains. Of the three stations, that on Markgrafen Strasse is the most important. It contains six engines of 160 horse-power each, each driving an old-fashioned Edison dynamo; with four other engines of 400 horse-power each, driving a new type of dynamo direct, at 80 revolutions per minute. These last dynamos are worthy of notice: they are multipolar Gramme machines, with radial poles inside the Gramme ring armature. There are ten poles; the armature is 3 metres in diameter; the commutator is 1½ metres in diameter. There are ten brushes, and the different circuits are connected in parallel. The advantage of this type of dynamo, provided it is an advantage, is in the slow speed at which it can be run. The capacity of the station is about 2,600 horse-power, which gives about 26,000 lamps of 16 candle-power. In the system of distribution employed, the two-wire plan is adopted, although in the later additions that are being made the three-wire system is to be used. The network of mains is supplied at intervals by "feeders," which are used to equalize the pressure at all points and times, there being no less than forty-two pairs of feeders. The cables consist of stranded wires covered with jute prepared with a bituminous compound, enclosed in lead, then covered with tape and a preservative compound, and finally armor-plated with two crossed spirals of iron ribbon. The cost of the underground cables for the whole system has so far amounted to about £90,000; the greatest variation of pressure allowed in the mains is 1½ per cent; the loss in the feeders at maximum load is 15 volts. The performance of the cables for three years was excellent; but Professor Forbes states that lately water has penetrated the lead, has percolated to the copper, which is then destroyed. "Whatever the cause may be, the fact seems to be established that such a cable will not stand underground electric-light work for more than about three years. These cables generally run under the footways without any casing."

The second of the three Berlin stations is in the Mauer Strauss. Besides supplying incandescent, it supplies arc lamps. The low-tension outfit consists of four Edison machines and six multipolar machines, supplying altogether 11,000 lamps.

The third station is small, and contains four Edison machines driven by the same number of 75-horse-power Armington & Sims engines. Fifty-two men are employed at the three stations in eight-hour shifts. The company which does the central-station work paid last year a dividend of 7½ per cent.

In the central station at Milan, both arc and incandescent lamps are supplied. Of the former, there are 350 of the Thomson-Houston system; of the latter, there are 16,000, fed by both the direct system and the alternating system. For the continuous system, Edison meters are used, and give great satisfaction. The distribution is on the two-wire system, as in Berlin, the current being supplied from ten Edison dynamos. The high-tension alternating system is the Zipernowski-Deri system, there being two machines, each of 2,000 volts and 40 ampères.

The capital of the company is $600,000, of which $120,000 has been spent in conductors Wages is one-fifth of the total working expenses; coal, one-half; lamp renewals, 7 per cent. The company has paid dividends for several years. The last was 4 per cent, and it is increasing. There is a large reserve fund.

The central station in Rome was started by the gas company there. The alternating system is used for both arc and incandescent lighting. At present 9,000 incandescent and 200 arc lamps are supplied. The number of alternations is 83 a second, or 41 complete periods a second. The greatest distance to which current is at present supplied is about three miles. The voltage in the primary circuit is 2,200; in the secondary, 110 volts. The converter is an anchor ring built up of iron disks wound over with the primary and secondary circuits. The dynamos are of two sizes. The smaller are of a size to supply 1,000 lamps. There are 20 poles, and the machine makes 250 revolutions a minute. The larger size have 40 magnet-poles, and make 125 revolutions. "When the machine is illuminated by an arc light, to which it supplies current, a curious optical effect is produced. The arc being periodically made and broken, the revolving magnet-poles are seen fixed in position, and the amount of lag with different loads can be seen distinctly. The efficiency of these machines is said to be 90 per cent, including the exciting current. There are 50 converters now at work, each of 10 horse-power. The efficiency of these converters is 95 per cent at full load; of the 5-horse-power converters, 92 per cent; of the 2½-horse-power, 88 per cent. After describing these stations, Professor Forbes proceeded to draw from his observations some lessons which will be of use to English engineers in the remarkable extension of electric lighting which is going on in that country, especially in London. He called attention to the fact that the continental low-pressure systems used a two-wire instead of a three-wire distribution: this he condemned as causing a great and needless expenditure for copper. Again the importance of feeding-wires was emphasized. Professor Forbes contrasted the variation in the potential of the lamps that would occur at a point 960 yards distant from the central station, using conductors which carried 1,000 ampères per square inch. For a two-wire system, the variation would be 48 volts in 100; a three-wire system, 12 volts; a three-wire system with feed-wires, the total amount of copper being the same as in the last case, 1 volt. The first two would evidently not be practical systems; the last would be satisfactory. In this connection, Professor Forbes pointed out that feeding-wires were also necessary in the high-potential alternating system, in order that the lamps should maintain a uniform brilliancy, and referred to the unsatisfactory showing of the Grosvenor Gallery Station, where the alternating system is used, and where no feeders are employed. Professor Forbes seems inclined to take a somewhat pessimistic view of the future of underground cables. Those in Berlin, he states, only last three years, and, "on looking through the testimonials of makers, he does not find that cables, when placed under ground, have ever worked electric-light circuits satisfactorily beyond the three years fixed by the Berlin people as being destructive." On this side of the water the Edison Company has done much better than this with their insulated copper rods carried in iron pipes. As the result of his observations on this point, however, Professor Forbes says, "At the present moment it seems to me that the only types of underground cables proved suitable for permanent work are either bare copper supported on insulators, or else vulcanized India-rubber, or perhaps okonite. Especial care must be taken to avoid an insulator which is injured by the gases which permeate the soil of a town, or which has the property, like pitch, of becoming viscous, and so letting the copper become decentralized.

It seems the experience of most electrical companies, that it pays better to use a meter on the consumer's premises, and charge for the actual amount of current consumed, than to supply light by contract. Of the different types of meters, the Edison and Avon meters can be used for continuous currents; the Schallenberger meter, for alternating currents. Professor Forbes thinks that the efficiency of converters for the alternating system is overrated. While the maximum efficiency might be from 90 to 95 per cent, yet the efficiency is much less on small loads, and he would be surprised if the average efficiency for all except two types would be over 70 per cent.

A great difference between the practice in this country and abroad is in the speed of the dynamos. Here very high speeds are used; abroad low speeds are aimed at. The advantage of the former is in the greater output and efficiency from the same-sized machine; the disadvantage is in the greater liability to accident; but, as these are extremely rare, the possibility of failure can hardly be regarded as balancing the advantages.

To an American reading the paper, there is the satisfaction that our own central stations are far in advance of those described; while nearly, if not quite, all of the recommendations are in the direction of the established practice in this country.

NOTES AND NEWS.

THE third field-meeting of the Indiana Academy of Sciences will be held at Greensburg, Ind., May 8, 9, and 10. The first meeting will be held at 7.30 P.M., Wednesday, May 8, at which time, in addition to miscellaneous business, a popular address will be delivered by Dr. J. P. D. John, the retiring president, upon "Our Celestial Visitors." As important business is to be transacted at this meeting, it is very desirable that as many members report as possible. It is particularly desired that all the members of the executive committee and of the committee on meeting of the American Association for the Advancement of Science at Indianapolis be present. The next day, Thursday, May 9, will be spent in the field along Cobb's Fork of Sand Creek. The citizens of Greensburg will furnish carriages. The creek will be followed for about four miles. Here are to be found the rarest plants of the county; the junction of the Lower and Upper Silurian, rich in fossils; and as much zoölogical material as can be found in the region. It will be a very profitable trip for all departments of field-work. Returning to Greensburg in the evening, another public meeting will be held at 7.30 P.M. This meeting will be of a somewhat varied character, consisting of brief reports by different members of the academy upon results of the field-work of the day. The meeting will be of special interest to the citizens of Greensburg, as they will hear discussed, in a popular way, the most interesting scientific features of their own vicinity. Friday morning another excursion will be made, as interesting as that of the day before. The details have not been fully determined, but every thing will be arranged for. This excursion of Friday will close the work of the academy.

— The abandonment of silk-culture in California, according to *Bradstreets*, is foreshadowed by the action of the governor of that State in vetoing an appropriation of ten thousand dollars made by the legislature to carry on experiments in that direction. The reason given is that California cannot compete with China or Japan in that industry.

— The solid matter present in mineral oils has recently been examined, says London *Industries*, by J. A. Le Bel, who has satisfactorily established the fact that asphalt obtained from petroleum and bitumen contains, in addition to an oxidized organic coloring-matter, a large percentage of inorganic constituents. The ash from a specimen of asphalt obtained from mineral oil procured from Egypt contained 11 per cent of lime and sulphur, while the asphalt derived from the Crimean oils yielded 6 per cent of ash. Purified asphalt from Lobsann, in Alsatia, gave 5.4 per cent of ash, consisting of lime, oxide of iron, silica, sulphuric acid, and a trace of manganese. The presence of silica in the ash, the author considers, supports the hypothesis of Mendelejeff, that the mineral oils are formed by the action of steam on the heated rocks of the interior of the earth. In the asphalt from Lobsann, Le Bel has also obtained 4.9 per cent of sulphur in combination with silicon.

— The manufacture of artificial coffee from burnt flour or meal is reported to be carried on by certain firms in Cologne. London *Industries* explains that the artificial beans are made in specially devised machines, and resemble closely in appearance the natural ones. They have been examined by O. Reitmair, who has shown that they consist of 34.6 per cent of extract soluble in water, mixed with 56.25 per cent of insoluble organic constituents. The amount of ash on ignition is small, amounting to 1.10 per cent. They can be readily distinguished from the natural beans by their property of sinking when immersed in ether, as genuine coffee-beans float on that liquid. Strong oxidizing agents do not decolorize the artificial product so rapidly as natural coffee.

— A correspondent of *The American Field*, after reading Greener's "Modern Shot Guns," noting that the author states that he has never known of snow causing the bursting of a gun when gotten in the barrel, vouches for its having done so in one instance, and believes it will in most cases, with ordinary charges, if the snow completely plugs the end of the barrel, though it may not cause as bad a burst as a more solid substance, as mud. Some years ago, while shooting with an English-made muzzle-loader, this correspondent got a small quantity of snow in one barrel, and carelessly discharged the gun before removing it, with the result that about an inch of the metal at the end of the barrel was torn away at top and side (being twisted and bent over toward the outside of the barrel). The recoil was not very great. The gun was a heavy one, with good-quality barrels, and the charge only ordinary or rather below the average. Doubtless the result would have been worse with more than a small quantity of snow in the barrel. The barrels were cut off below the break, and have been used many times since.

— Dr. A. T. Hudson of Stockton, Cal., has made a statement which, in the opinion of *The American Field*, will be contradicted by scores of people. Dr. Hudson asserts that whiskey is no antidote for rattlesnake-poison, on experiments made by Dr. S. Weir Mitchell. He says, "Dr. Mitchell mixed the virus of the rattlesnake with alcohol and with other reputed antidotes, and found, on injecting the solution into animals, that its power was not altered. He found also that the effect of the virus was subject to very well defined limits, and that a quantity which would kill an animal of a certain size was much less powerful or inert upon larger animals. If a large snake should bite a goat of about fifty pounds weight, and afterward two children of corresponding weight, he might kill the goat, while the children would survive, because not enough virus was left after the goat was bitten seriously to harm the children; then, if whiskey were given to the children, their recovery would be attributed to it, while it really had nothing to do with the matter. It is rare that an adult person dies from the bite of a rattlesnake. Whiskey may, however, be regarded as physiologically antidotal, in so far as it will sustain the flagging powers while the poison is being eliminated by the excretory organs."

— For a long time the quarters occupied by the live animals at the Smithsonian Institution, Washington, D.C., have been infested by rats; and every means known for their destruction or extermination have been used, but all to no purpose, as the rats are steadily increasing in number. They seem to know what rat-traps are for, and keep out of them, no matter how tempting the bait. But last week, according to *The American Field*, Capt. Weedin, who has charge of the animals, made a valuable discovery, by means of which he expects to clear the place of these destructive vermin. In a storeroom drawer a quantity of sunflower-seeds, used as food for certain of the birds, was placed, and it was noticed that the rats eagerly gnawed their way through the drawer to get at the seeds, which they evidently relished. Acting on this supposition, Capt. Weedin baited his rat-traps with the seeds, and there was no more astonished man in Washington than he was when he discovered, the next morning, that every trap so baited held from ten to fifteen rats each. The rats were turned into the cages containing the weasels and minks, which did the killing in less time than it takes to tell it. The minks would kill the rats instantaneously.

— The Ventura Society of Natural History was organized in San Buena Ventura, Cal., in June, 1884. It numbers about fifty members, and holds its meetings once a month. The society has made collections in minerals, fossils, conchology, botany, etc. Rev. Stephen Bowers, Ph.D., has been president of the society from the time of its organization. Congressman Vandever and other prominent men are active members; and while but a small proportion of its members have time for original investigation, yet it is said to be doing good work in some departments of science. Dr. Bowers has been instrumental in securing one of Mr. Alvan Clarke's best six-inch lens telescopes, which will be erected upon an eminence north of the city overlooking the Santa Clara valley of the south, the Pacific Ocean, and the coast range of mountains.

— A very interesting report to the United States Hydrographic Office from Commander Allen D. Brown, U.S.N., commanding the U.S.S. "Kearsarge," shows an abnormal state of the weather and ocean-currents about Barbadoes. From March 16 to 25 the trades disappeared entirely, being replaced by calms and light variable winds, chiefly from the westward, with frequent rain-squalls, — most unusual weather. March 19 and 20, strong south-easterly currents were observed (to the southward and eastward of the island), thirty and twenty knots a day respectively; March 29, between Barbadoes and Martinique, a current setting due north, ten

knots in fourteen hours; and in the passage between Martinique and Santa Lucia, four knots in one hour, and eight in four hours. Both the last two observations were by bearings.

— The International Congress of Anthropology and Archæology will hold its tenth meeting at Paris. When the congress adjourned at Lisbon, in 1880, no arrangements were made for future sessions. Notwithstanding numerous endeavors to bring about a new meeting, the congress did not assemble for eight years. In July, 1888, a number of French anthropologists, who considered the great International Exhibition a good opportunity of re-organizing the congress, proposed to the permanent committee of the congress to arrange for a meeting in the present year. A committee was appointed, the president of which is the eminent anthropologist, A. de Quatrefages, and invitations have been sent out. The congress will hold its tenth meeting at Paris from Aug. 19 to Aug. 26. The following questions are proposed as subjects of discussion by the committee: (1) the erosion and filling of valleys and caverns in reference to the antiquity of man; (2) the periodicity of glacial phenomena; (3) art and industry of the caves and of the alluvium; value of paleontological and archæological classifications applied to the quaternary epoch; (4) chronological relations between the stone, bronze, and iron ages; (5) relations between the civilization of Hallstadt and other Danubian stations, and those of Mycenæ, Tiryns, Issalik, and of the Caucasus; (6) critical examination of quaternary crania and bones found during the past fifteen years; ethnical elements of the various stone, bronze, and iron ages of central and western Europe; (7) ethnographical survivals, which may throw light upon the early inhabitants of central and western Europe; (8) how far do archæological and ethnographical analogies justify the hypothesis of affinities or prehistoric migrations?

— At the meeting of the New York Academy of Sciences, April 22, Mr. John C. Henderson read a paper on the proposed Tehuantepec Ship Railway. Mr. Henderson's paper was followed by an interesting discussion, which is reported in *The Railroad Gazette*. Gen. Andrews said that canals had played a conspicuous part in past history, and even now they have not fallen into disuse, and in countries of a lower grade of civilization, such as China, they are the chief arteries of commerce. It is estimated that the traffic on the canals of China equals, or perhaps exceeds, the combined commerce of all the rest of the world. But progressive nations are abandoning canals, and substituting railroads. Experience proves that railroads can work cheaper than canals. If New York State should fill up her Erie Canal, and build a four-track railroad, she could haul freight over it cheaper than the canal-boat can carry it. Estimates which he regards as incontrovertible show that a ship can be hauled by a locomotive over a ship-railroad, or, as he prefers to designate it, a ship-tramway, with the expenditure of only one-half the amount of coal which the same ship must burn to propel herself through the water of a canal. The most frequent objection urged against the practicability of the scheme is that it would rack the ship; but Gen. Andrews explained that the weight is so distributed among the numerous supports that no one need sustain a greater weight than a man presses upon his foot in walking. The gradients of the route will be very slight, not exceeding two inches in four hundred feet, the entire length of a vessel. He had made observations, during a voyage aboard the steamer "Britannic," to measure the amount of strain to which she was exposed in a sea of no very great roughness, and found by stretching cords that the steamer was bent sixteen inches by the waves, but without the slightest injury: hence he infers that the stress on a vessel in crossing the isthmus would be inappreciable and harmless. A powerful argument, he holds, in favor of the Tehuantepec route, is that it is the nearest to this country, and is in the region of winds, so that sailing-vessels could use it; whereas Panama is almost a dead calm, and even Nicaragua is not to be depended on by sailing-vessels. The result of opening either of the southern routes, therefore, would prove to be, as the Suez Canal has already proven, that the route would be monopolized by British steamers, and that the American flag would not be seen. President Newberry said that the proposed scheme appears to be practicable, but that it is so novel as to seem to require the test of experience before we can be certain that all practical difficulties will be successfully met. The smaller ship-railroad from the Bay of Fundy to the Gut of Canso is being rapidly constructed, and will probably be in operation by about September, 1890. The results will be watched with interest, and, if successful, the larger work at Tehuantepec will undoubtedly soon follow.

— It is stated, that, notwithstanding the threatened opposition of the English Government, the Channel Tunnel Company will proceed with the bill which it proposes to bring before Parliament, and take a division upon next session. It is said that since last year the promoters have received great encouragement to proceed, particularly from a large number of persons connected with the manufacturing and commercial centres of England and Scotland. They have also in many cases been promised the support of several members of Parliament. The following from *Iron* (London) gives the present status of the tunnel: "The machinery which was used for boring the tunnel is still in the heading, and is periodically set in motion to keep it in order; but no attempt is made to advance the heading, the length of which measures about 2,100 yards. It is now two years since the works were stopped; and the tunnel is said to be so far impervious to water, that, on an average, not more than 400 gallons has found its way into the entire heading in the course of twenty-four hours. The boring operations for coal near the mouth of the tunnel still continue, and a depth of about 1,000 feet has now been attained. The character of the strata is such as to encourage the continuation of the operations in the hope of ultimately finding coal. While the prosecution of the borings for coal ought to be encouraged in every way, the same cannot be recommended for the tunnel-works. In the present state of public opinion, the money spent that way will only be wasted."

— An alarming illustration of the facility with which steel corrodes under certain conditions, the *Engineer* says, has just been observed at Portsmouth, England. H. M. S. "Nile" was launched at Pembroke on the 27th of March last, since which time, as there is no dock accommodation at the Welsh yard, she had been afloat in her launching trim without there being any opportunity afforded of examining and protecting the under-water parts of the hull. When she was placed in No. 13 dock at Portsmouth for the purpose of removing the launching gear, and changing her temporary propellers, it was discovered that the red lead with which her bottom was coated had extensively peeled off, and that serious corrosion of the plating all along the water-line on both sides had taken place. The starboard side amidships was very much pitted, though, as a rule, the pitting and scoring were tolerably uniform. The rivet-heads were greatly corroded, and in many instances they appeared to be completely eaten away. The same is said to be the case with some of our new steel war-vessels, the steel being extensively pitted, especially along the water-line.

— Although West Indian hurricanes may be encountered during any month of the year, yet there is such a marked increase in their number and violence during July, August, September, and October, that these four months constitute what is called the hurricane season. In regard to the hurricane regions, the United States Hydrographic Office says that they include the tropics north of the 10th parallel, the Caribbean Sea, Gulf of Mexico, and a broad belt curving north-westward from about St. Thomas, and following the Gulf Stream towards the Grand Banks of Newfoundland. The earliest indications are unusually high barometer, with cool, dry, fresh winds, and very transparent atmosphere; a long, low ocean-swell from the direction of the distant storm; light, feathery plumes of cirrus clouds, radiating from a point on the horizon where a whitish arc indicates the bearing of the centre. Unmistakable signs are the following: As the cirrus-veil spreads overhead, with halos about the sun and moon, the barometer begins to fall, slowly but steadily, and the ocean-swell increases; the air becomes heavy, hot, and moist; dark red and violet tints are seen at dawn and twilight; the heavy cloud-bank of the hurricane soon appears on the horizon, like a distant mountain-range; the barometer falls more rapidly, and the wind freshens, with occasional squalls of fine, misty rain. As regards the general size and velocity of progression, the storm area is smaller in the tropics than farther north, the

cloud-ring averaging about five hundred miles in diameter; and the region of stormy winds, three hundred miles, or even less. In low latitudes the entire storm moves westward and north-westward, about seventeen miles an hour; in middle latitudes, north-westward and northward, moving more slowly as it recurves; and finally north-eastward, with a velocity of translation of twenty or even thirty miles an hour, its area increasing rapidly as it follows the Gulf Stream toward the Grand Banks, and sweeps across the Atlantic toward northern Europe.

— The weather forecasts for May of the Hydrographic Office are, that fair weather will prevail generally over the North Atlantic with occasional northerly gales along the American coast, and moderate north-westerly gales along the transatlantic steamship routes, north of the 40th parallel. Northers in the Gulf of Mexico will occur less frequently, and be of less duration, but are liable to be of great violence. There will be a notable increase of fog off the Grand Banks, due to the northward movement of the Gulf Stream and the southward extension of ice brought down by the Labrador current. Icebergs and field-ice may be encountered almost as far south as the 40th parallel, between the 41st and 58th meridians.

— A large assemblage of men and women who are interested in the discussion and study of psychological matters gave Professor Elliott Coues a hearty reception at Cartier Hall, 80 Fifth Avenue, New York, Wednesday evening, April 24, when he lectured on modern miracles.

— The semi-annual meeting of the American Antiquarian Society was held at Boston, April 24. President Salisbury presided. The secretary reported the acknowledgment by Gladstone of his election as a member of the society. The report of the treasurer made the following showing: cash investments, $107,141; cash on hand, $7,609; amount of the thirteen funds, $105,937. On motion of Senator Hoar, the society voted to ask the Rev. Dr. Hamlin to prepare a history of the Roberts College, Constantinople, together with the attitude of the Turkish Government toward it.

— The executive committee of the International Exhibition of Geographical, Commercial, and Industrial Botany, to be held at Antwerp in 1890, we learn from *Nature*, has decided to celebrate on this occasion the three hundredth anniversary of the invention of the microscope. It proposes to organize what it calls a retrospective exhibition of the microscope, and an exhibition of instruments produced by living makers. Conferences relating to all important questions connected with the microscope will also be held. The exhibition ought to be remarkably interesting, and will no doubt be a great success.

— According to a recent statistical return, 12,486,407 hectolitres (hectolitre = 22 imperial gallons) of beer were produced last year in Austria, Bosnia, and Herzegovina, — a falling-off of 190,019 hectolitres as compared with 1887. The exports, however, increased by 9,087 hectolitres, having amounted to a total of 250,963 hectolitres.

— Professor Liebreich, at a meeting of the Berlin Physical Society, March 22, exhibited a series of experiments intended to explain the occurrence of the inert layer in chemical re-actions. Two years ago, we learn from *Nature*, he had demonstrated to the society the chief phenomena of its occurrence, as seen when a solution of sodium carbonate is mixed with chloral hydrate. When this is done, the larger part of the mixed fluids very soon becomes milky, owing to the formation of innumerable small drops of chloroform, while at the same time a thin layer on the surface of the fluid remains clear. This clear portion is the inert layer, and is bounded above by the general meniscus of the mixture, and below by a curved surface, whose convexity is turned upwards towards this meniscus. The speaker had, by means of a series of experiments, disposed of the view which had been put forward, that the inert layer is only a portion of the mixed fluids, from which the chloroform had evaporated. Of these experiments it may suffice to mention only one, in which the fluid was poured into a flat, open basin until it projected with a convex surface above the edges of the basin. Notwithstanding the larger fluid-surface thus exposed, no inert layer was to be seen. Similarly he had been able to show, by observations under the microscope, that the phenomenon cannot be explained by any vortex movements in the fluid. Further, the assumption that it is due to a solution of alkali from the glass, which then prevents the precipitation of the chloroform, had been excluded by using a vessel made of quartz crystal. Professor Liebreich inclined to the view, on the basis of his past experiments (which, however, must be further followed and extended), that the suppression or slowing of the chemical re-action at the surface of the fluid, which gives rise to the inert layer, is determined by the greater solidity and resistance of this part of the liquid.

— At the Massachusetts Agricultural College Experiment Station, according to *Garden and Forest*, pollen was taken from a carnation-flower of a magenta color, and, after being kept in a dry place for five days, was applied to the stigmatic surfaces of a yellow flower. From twenty-seven seeds obtained by this crossing, nineteen plants were grown, all but one of which produced double flowers. Five of them bore yellow flowers of various lighter and deeper shades, eight bore magenta flowers, four bore scarlet flowers, and two white-striped flowers. In another trial the pollen used was taken from a flower of the same variety, — in this case a yellow-striped one, — and the seedlings all showed yellow-striped flowers, although they varied somewhat in shade. This seems to indicate that for the production of varieties distinct in color, cross-fertilization is a necessity.

— *Garden and Forest* quotes this simple method of testing the quality of a pear: write a name with pen and ink upon the dry skin of the fruit. If the ink is quickly absorbed, leaving clear, sharp lines, the quality of the fruit is good; if the skin does not absorb the ink quickly, and the lines are blotted, the quality in inferior.

— Four articles have been prepared at Harvard College Observatory in successive years, with the object of exhibiting, so far as conveniently practicable, the recent progress of observations of variable stars. These articles were published in the "Proceedings of the American Academy of Arts and Sciences." An index to observations of variable stars, just published, is intended to provide similar information for the entire period from the beginning of 1840 to the end of 1887. It makes no pretension to absolute completeness, which would not at present be attainable; but it may still prove serviceable as a further step towards the systematic arrangement which is so much to be desired in the existing mass of information respecting variable stars, and in the absence of which the profitable study of their changes is extremely difficult. The observations are in general unpublished, and have been reported to this observatory by the astronomers who made them. It may be hoped that this record of their existence will in some cases insure their preservation, and make them available to future inquirers. It will also show to what extent particular variable stars have been observed at particular times, and will thus serve to guide observers in the selection of stars for future observation. Three large series of unpublished observations by Argelander, Heis, and Schmidt, important both from their early date and from the reputation of the observers, are mentioned.

— Mr. C. Carus-Wilson writes, in a letter to *Nature*, that he has devised a simple and effective dry method by which the denser minerals — zircon, rutile, tourmaline, etc. — may be separated from sand. A piece of cardboard about two feet long is bent in the form of a shoot or trough (it must not be allowed to break), and held in this form by elastic bands at either end. This must then be held, or fixed, at an angle sufficiently inclined to allow the sand to travel slowly down the shoot on being gently tapped. A small quantity of the sand to be treated is now placed at the head of the trough, which is then tapped with the finger. When the trough is tapped, the sand travels slowly down; and, in doing so, the denser grains lag behind, forming a dark mass in the rear of the stream. This dark mass increases as the sand flows on, and must be collected and placed in a receptacle just the moment before the last tap would cause it to fall off the trough. When a sufficient quantity of this denser sand has been thus collected, it should be placed in the lid of a cardboard box (about twelve inches by six), and gently shaken to and fro at a slightly inclined angle, the mass being

at the same time gently blown upon with the breath. The finer quartz-grains will thus be blown away, and hardly any but the denser grains will remain.

— During last year the archæological researches that have been carried out in Norway were extended as far north as 70° 15′ north latitude, according to *Nature*. The results appear to show that the islands and the coast were well populated in prehistoric times, but that the cultivation of the soil did not begin until a late date. Numerous burial-places were found; and among the weapons and implements discovered were schist arrow-heads, knives of three kinds, and chisels. No stone axes like those found in the south were discovered. From the fact that no bronze objects have ever been found in the north of Norway, it is concluded that the inhabitants of the stone age, on coming in contact with those of the early iron age, adopted the use of iron, and never learned the use of bronze. It is worthy of note that all the implements from the stone age are of schist, none being of flint, as in the south.

— At a meeting of the Berlin Physical Society, March 22, Dr. Assmann gave, according to *Nature*, an account of the results he had obtained by a microscopic examination of the structure of rime, hoar-frost, and snow. In opposition to the view most usually held, that the solid condensations of aqueous vapor from the air are crystalline, he had observed some years ago, during a sojourn in winter on the Brocken, that hoar-frost consists of amorphous frozen drops, which, by their juxtaposition in rows, build up the long needles of which it is composed. He observed the same structure in some rime which he had collected from very various objects in December last, during a cold which was not at all intense; in this case, also, the spicules of ice were composed of amorphous drops of ice frozen together in lines. In one case the little masses of ice which composed the rime were frozen together into a leaf-like structure. At the same time some small, scattered, and glittering ice-formations which had been formed in large numbers on the ground were crystalline in structure, consisting of thicker or thinner six-sided tablets or somewhat elongated prisms. On other occasions he found that the rime was itself composed of unequally developed crystalline structures, which branched at angles of sixty degrees, and thus gave rise to a dendritic formation; at the same time the hoar-frost was also composed of crystalline structures. He had also succeeded in forming ice-flowers artificially on a pane of glass, and had satisfied himself by a microscopic examination of the same that they are always crystalline in structure. The structure of snow was investigated on the snow-garlands which had been described at a meeting of the Meteorological Society, and consisted of amorphous granules, such as compose the upper surface of a glacier. Dr. Assmann attributes the formation of rime and of hoar-frost to the existence of over-cooled drops of water, which suddenly solidify when driven by the wind against the solid substructure on which they are found. On the other hand, solid transparent ice is formed when water at 0°, or some temperature above zero, comes in contact with any solid object whose temperature is very low.

— At a meeting of the Berlin Meteorological Society, April 2, Professor Börnstein spoke on the ebb and flow of the tide. After explaining the nature of the moon's action on the fluid part of the earth's surface, and showing that the flood is essentially due to a diminution of gravity and the ebb to its increase, says *Nature*, he passed on to the consideration of the moon's attraction as it affects the atmosphere. Many experiments have been made with a view to proving the influence of the moon on the atmosphere; and at various places observers have succeeded in establishing a daily variation in the pressure of the air dependent upon the moon, and showing two maxima and two minima. These places are Singapore, St. Helena, Melbourne, and Batavia. The amplitude of the variation amounted to from 0.079 to 0.2 of a millimetre. But opposed to these are the observations of Laplace on the variations of the barometer in Paris, as also of Kreil in Prague, and, further, Bessel's observations on atmospheric refraction. All these last-named observers found that the action of the moon on the earth's atmospheric envelope was either *nil* or else the reverse of that described above. Professor Börnstein then discussed the question whether any ebb and flow of the atmosphere could possibly be detected with the means now at our disposal, and showed that the mercurial barometer can never be able to give indications of any such action, since it is itself affected by the alterations of gravity which are due to the varying position of the moon. He explained the phenomena observed at the four stations mentioned above as due to the fact that they are situated either on the sea-coast or on islands, at places on the earth's surface at which the ebb and flow of the sea is very considerable. The ebb and flow of the sea acts secondarily on atmospheric pressure, especially by means of the alteration of surface, and gives rise to corresponding increases and diminutions in that pressure. Paris, Prague, and Königsberg are, on the other hand, inland stations, at which the barometer cannot be affected by any variations on the level of the sea's surface.

— The public funeral of M. Chevreul, which took place in Paris, Saturday, April 13, says *Nature*, was one of great splendor. This was due in part, no doubt, to the interest excited by M. Chevreul's extraordinary age; but it must also be taken as a striking indication of the respect felt in France for men who achieve eminence in science. In front of the house in which M. Chevreul died, beside the Jardin des Plantes, a tent was fitted up as a chapel; and here the body was placed in state. The procession to the Cathedral of Notre Dame was headed by a detachment of police, who were followed by a platoon of cuirassiers, the 103d Infantry Regiment, with flags and a band of ushers, carrying wreaths presented by the stearine-makers of France, the stearine-makers of Lyons, the Friendly Society of Anjou living in Paris, and a large number of other public and private bodies. Last of all came a wreath sent by the Gobelin Works, surrounded by a woollen fringe dyed by M. Chevreul himself. The pall-bearers were MM. Fallières, minister of public instruction; Louis Passy, president of the Society of Agriculture; Chaumeton, president of the Students' Association; Des Cloizeaux of the Academy of Sciences; Quatrefages of the Academy of Sciences; Chautemps, president of the Municipal Council of Paris; and Roy, manager of the Society of Arts and Manufactures. Next came the members of M. Chevreul's family, grandchildren and great-grandchildren; and they were followed by the representatives of the president of the republic, by several of the ministers, the presidents of the Senate and the Chamber, and representatives of all the great educational and scientific bodies and administrative departments. At Notre Dame there was an impressive religious service. The interior of the church was hung with black; and over the porch, whlch was also hung with black, was a scroll bearing the dates "1786–1889." In the centre of the choir was a catafalque resting on silver columns, and surmounted by a canopy with bands of ermine. After the religious ceremony, the body was removed to L'Hay, and interred in the family vault. In compliance with M. Chevreul's last wishes, no speech was made over his grave.

— The Massachusetts Agricultural College, says *Agricultural Science*, is in a most prosperous condition. At no time, with one exception, has there been a larger attendance of students; the total for the year 1888–89 being 149, the freshman class being 48. The library contains 8,285 volumes, and during the year the students drew out on an average 14 books each. Of the graduates of the college, 46 are farmers, 6 fruit-growers and market-gardeners, 8 florists and landscape-gardeners, 4 planters, 9 poultry and stock raisers, 7 veterinarians, 2 editors of agricultural papers, 4 fertilizer manufacturers, 9 chemists to fertilizer companies, and 28 engaged in agricultural colleges or experiment stations. There are 150 other graduates engaged in various occupations. The college farm is being much improved, and has 46 head of cattle, consisting of Jerseys, Guernseys, Short-horns, Holstein-Friesians, and Ayrshires, 31 pigs, and 23 Southdown sheep. In 1888, 212 tons of hay were cut from a little over 80 acres of land.

— The officers of the Boston Society of Natural History for 1889–90 are, president, F. W. Putnam; vice-presidents, John Cummings, G. L. Goodale; curator, Alpheus Hyatt; honorary secretary, J. C. White; secretary, J. Walter Fewkes; treasurer, Charles W. Scudder; librarian, J. Walter Fewkes.

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THE "PILOT CHART" of last month contained a small telegraph chart (reproduced in *Science* of April 5) of the Bay of North America, to illustrate the admirable facilities that exist for the establishment of a more complete system of telegraphic weather-reports and storm-warnings for the benefit of commerce, to include Mexico, Central America, the West Indies, and the Windward Islands. A hurricane chart accompanying the "Pilot Chart" for May, with the tracks of a few hurricanes selected as typical of those that occur in this region, illustrates still more strikingly the importance of this project, besides containing information of value to navigators during the coming hurricane season. The recent terrible disaster at Samoa, March 16, caused by a tropical cyclone, may well call attention to the fact that West Indian hurricanes are among the most severe that occur anywhere in the world. Every consideration of expediency, economy, and common sense, urges the importance of taking full advantage of every possible facility for getting early and reliable information regarding the formation and progress of these terrific storms, for the benefit of commerce along the Atlantic and Gulf coasts, and in the West Indies, the Caribbean Sea, and the Gulf of Mexico. The completion of the Nicaragua Canal will add tenfold importance to this subject, but its importance to American commerce is already so great that such a system should be in full operation now.

THE SEVENTH ANNUAL REPORT OF THE DIRECTOR OF THE UNITED STATES GEOLOGICAL SURVEY.

EVER since the foundation of the present United States Geological Survey, its scope and fitness to accomplish the great work intrusted to it, have grown, its work thus steadily gaining greater economic and scientific importance. It would be useless at the present day to dwell upon the value of geological work, to the appreciation of which the people of the United States have fully awakened. Even the people of the Western States, who are so entirely guided by practical considerations, acknowledge their necessity by appropriating funds for geological investigations or by maintaining geological surveys.

The lack of trustworthy maps has compelled the United States Geological Survey to include this indispensable preliminary work in its operations, and the great and important work is furthered with commendable energy. Ever since the first of the topographic sheets were printed, and since they have become accessible to the public, the demand for such maps has increased, and the lack is more sorely felt in regions where they do not exist. The publication of the map of New Jersey, the first of the States that can boast of a good map, and the imminent completion of the map of Massachusetts, will greatly help to bring home to the public the necessity of providing for the publication of the maps of the whole country. In the year 1886, considerable portions of New Jersey and Massachusetts, of the Appalachian region, of Kansas and Missouri, a portion of Texas, a small part of Arizona, and several valleys of California, were surveyed, and the mapping of the Yellowstone National Park was completed.

Regarding the scope of the geological work of the survey, the following passage of Major Powell's report will be read with interest: "The Geological Survey inherited much unfinished work of different surveys in the Western Territories, previously prosecuted under the auspices of the government. Since it seemed desirable to carry forward and complete these surveys as rapidly as possible, investigations were continued in the fields covered by them, and thus the early organization of the survey was determined in part by antecedent geologic work. At the same time, however, demands for local geologic and mineralogic investigations came from various portions of the country, including the older and long settled States; and, as soon as the legality of such action was established, the geologic operations of the survey were extended into the other States, and a number of divisions were organized, and intrusted with the investigations.

"It should be explained that by its organic law the Geological Survey is inhibited, both implicitly and directly, from making a geologic survey upon a cadastral plan; i.e., from making investigations relating to the value of properties of individuals. Accordingly, its work in economic geology is limited to the observation and mapping of the formations within which mineral resources lie; the general distribution and characteristics of coal-beds, ore bodies, and other valuable mineral deposits; and the investigation of questions relating to the origin and taxonomic relations of the formations themselves and of their contained minerals.

"Within the above limitations it has been found possible to make the scientific investigation of the survey of high economic value (1) by extending its operations into those portions of the different States in which the natural resources have not yet been fully developed, and (2) by developing and applying such systems of classification of the formations as will at the same time enable and compel the geologist to discriminate in the field, and clearly distinguish on the maps of the survey those rock-masses which are economically important. Both of these means of rendering these investigations of the survey of maximum value to the country have been adopted. Moreover, friendly relations exist between the United States Geological Survey and the geologic surveys prosecuted under the auspices of different States of the Union; and in many cases partial co-operation with these States has been effected in such manner that the State geologists leave to the federal survey the investigation of such general scientific questions as involve operations beyond the limits of their own States as well as within them, and avail themselves of the results of this investigation, and in return permit the general survey to utilize the results of their own more strictly economic studies."

We cannot enter into a detailed description of the work in the various divisions of the geological branch of the survey which cover extensive portions of the United States. Professor R. Pumpelly continued his researches on the archæan geology of the New England States; Mr. G. K. Gilbert, those on the Appalachian region. Of considerable practical as well as scientific interest, are Professor N. S. Shaler's researches on the swamps of the Atlantic coast. It is estimated that there are 100,000 square miles of coastal lands in the country, which, subject to inundation by tidal and fluviatile waters, are valueless in their present condition. It would appear, from the experience of other countries, that, by the employment of proper methods, these lands might be reclaimed, and rendered among the most valuable of the agricultural lands of the United States. But the relative altitude of land and sea is not constant: in some places the ocean is encroaching upon the land, and elsewhere the land is emerging from beneath the oceanic waters; and even where the level of the coastal land is stationary, the shores are undermined and eaten away by the waves, and thus the sea gains upon the land in another way. The examination of the causes of the changes of coast-line must, in some cases, precede engineering operations for reclaiming land. Connected with these questions of oscillation of the land and the formation of coastal marshes, is that relating to the origin and distribution of the bog ores, phosphatic beds, etc., now in process of formation in the marshes of the Atlantic coast, and embedded in the cenozoic formations thereof, constituting one of the most important of the mineral resources of the Atlantic States.

Other important branches of the geologic division are the surveys of the copper-bearing rocks of the Lake Superior region, Professor T. C. Chamberlin's investigations on glacial geology, and the various Western surveys.

The present report is accompanied by a number of important papers, each illustrative of another part of the work of the survey. Professor T. C. Chamberlin treats the rock-scorings of the great ice invasions; Mr. Joseph P. Iddings describes the structure and petrographic character of Obsidian Cliff in the Yellowstone National Park. The classification of the early Cambrian and the pre-Cambrian formations is the subject of a paper by Mr. R. D. Irving. Professor William Morris Davis's paper on the structure of the triassic formation of the Connecticut valley gives a preliminary sketch of the work done by the archæan division, in charge of Professor R. Pumpelly. The division of mining industries is represented by T. M. Chatard's paper on salt-making processes in the United States.

There are two geological monographs on limited areas: Mr. W. J. M'Gee's description of the geology of the head of Chesapeake Bay, and Professor N. S. Shaler's report on the geology of Martha's Vineyard. After a survey of the Island of Nantucket, Professor Shaler undertook an investigation of the Island of Martha's Vineyard, and the results of this work are embodied in the present monograph.

He found that the front of the ice during the last glacial period remained for some time on the Island of Nantucket. After the disappearance of the ice, the region was suddenly elevated above the level of the sea, after having been depressed below its level during the continuance of the glacial conditions. Since that time it has undergone a depression of about twenty feet. From Professor Shaler's investigation on Martha's Vineyard, it appears that the tertiary beds of that island belong to a great delta deposit accumulated during the middle and later stages of the tertiary age; they have been subjected to a considerable amount of dislocation by the action of mountain-building forces; they thus indicate the action of these forces at a much later date than any for which they have been observed elsewhere on the eastern shore of the continent. Among the interesting studies incident to this inquiry is that of a bowlder train originating in a hill having a diameter transverse to the motion of the ice of less than one thousand feet. Professor Shaler found that it has a fan-like shape; being, at a distance of fifteen miles from the point of origin, not less than eighteen thousand feet in width.

The report is printed and illustrated as beautifully as all the preceding reports. In the brief space allotted to us we can do no more than call attention to some of the important contributions contained in it. The fortunate combination of work that is of scientific and economic value, which is characteristic of our Geological Survey, cannot fail to bring home to the minds of the people the necessity of work of this kind and its eminent usefulness to the public good.

TWELFTH ANNUAL REPORT OF THE NEW JERSEY STATE BOARD OF HEALTH.

IN addition to the valuable and suggestive report of the secretary, Dr. E. M. Hunt, this volume contains the following articles: I. "The Sanitary Necessity for the Control of the Construction of Dwellings," by Henry Mitchell, M.D. In support of the ground which he takes, that there is such a necessity, the writer refers to the fact, that, of two hundred houses examined in Chicago in which diphtheria existed, but four were perfect in their sanitary arrangements. The same has been found true in other cities. He claims, that, by the loss of life in New Jersey from diseases which are preventable, the State loses annually $5,576,000; if consumption is added to this list, the amount would reach $12,000,000. A satisfactory organization for health-protection could be made at an expense of fifty cents per capita of the population. II. "Our Charitable and Penal Institutions," by Ezra M. Hunt, M.D. In this paper Dr. Hunt describes the condition of the almshouses, jails, etc., of the State, and makes suggestions for their improvement. III. "Water-Supply from Wells, in its Relation to Health," by Francis A. Wilber, M.D. The writer of this paper discusses (1) the source of supply of well-water; (2) its collection; (3) the sources of its impurities; (4) nature's means for removing such impurities, and the failure of these means; (5) the relation between these impurities and public health. He says that absolutely pure water is one of the greatest luxuries of modern life; and nothing in our modern civilization marks more strongly public enlightenment in matters of health than does the interest now being taken in the subject of water-supply for towns and cities. IV. "Ice as a Source of Disease," by William K. Newton, M.D. Several instances are given in which ice was the cause of sickness. Dr. Newton says that it has been abundantly proved that the use of ice cut from streams, ponds, or lakes polluted by sewage or organic refuse of any kind, is dangerous to health. V. "The Water-Supplies of New Jersey," by A. Clark Hunt, M.D. In this paper the writer gives the population of the principal towns and cities of the State, the number of houses contained therein, the source of the water-supply, the size of the reservoirs and of the water-pipes, the daily consumption and the character of the water. VI. "Diseases of Workers in Textile goods," by Drs. J. W. Stickler and J. B. Stubbart, and Mr. F. B. Lane. This is a continuation of the inquiry into State industries, which has been carried on by the State board for a number of years, to the value of which we have frequently referred.

The secretary, in an introduction, well says that it is the high duty of the State to see to it that those upon whom it must depend for productive labor are enabled to pursue that labor without undue peril to health and life: hence all machinery should be properly guarded, all factories should be examined by those expert in detecting the causes of ill health or undue exposure, and those of younger age should be protected from kinds and degrees of work unfavorable to full development and to proper schooling. As a result of the inquiry into the health of those who work in woollen goods, the reporters say, that while there is a slight tendency to bronchitis, catarrh, and rheumatism, workers in wool are to be congratulated on having an occupation which is not necessarily unsafe or unhealthy. They say, however, that there is need of more care as to dust. Workers in cotton suffer from diseased conditions much more than workers in wool, owing to the large amount of dust and the overheated rooms. Of 72 employees engaged in this work, 11 had catarrh; 7, headache; 8, rheumatism; 4, malaria; 2, bronchitis; 3, sore eyes; 3, sore throat; 1, pneumonia. Rheumatism and catarrh are the prevailing deseases. VII. "Means for Preventing the Spread of Contagious Diseases in Cities," by J. C. Bayles, M.E., president of the New York Health Department. This paper describes the methods and appliances employed by the New York department, including the three hospitals for the care of contagious diseases, and the disinfecting plant. D. C. English, M.D.,

furnishes a report of the papers and discussions of the New Jersey Sanitary Association, which met in Trenton during December, 1888. Reports from local boards of health, and health laws and circulars, together with vital statistics, are also given in the report.

BOOK-REVIEWS.

Psychology as a Natural Science applied to the Solution of Occult Psychic Phenomena. By C. G. RAUE, M.D. Philadelphia, Porter & Coates. 8°. $3.50.

THE author of this work is by birth a German, and as long ago as 1847 he published a little book in the German language which is the nucleus of the present treatise. His psychological views are those of Beneke, whom he regards as the real founder of scientific psychology. In this work, however, the author's special object has been to explain the various "occult phenomena," such as hypnotism, thought-transferrence, etc., which have of late attracted so much attention; and the views presented on these subjects are the result of his own researches. The earlier part of the work is simply an ordinary treatise on psychology, containing some doctrines peculiar to the school of Beneke, but on the whole traversing pretty familiar ground. The author holds that all our states of consciousness and all our mental capacities arise from two sources, — the primitive or original forces of the soul, and the stimuli of the external world; the primitive forces, as he is careful to tell us, comprising nothing but the powers of sense. These primitive forces he also divides into two classes, — those that have been modified by external stimuli, and those that have not been thus modified, and which he calls void, unoccupied primitive forces. These forces and stimuli together he calls "mobile elements," by which we suppose he means active elements. These, then, being the sole sources of knowledge and mental power, the problem is to explain by means of them the occult phenomena in question. Dr. Raue holds that physical causes are wholly inadequate to the purpose, and that nothing but psychical forces will account for the facts. The soul he defines as "an organism of psychic forces externalizing itself in the organism of material forces which constitute the body. . . . The psychic forces are spaceless. . . . They act where they are, and yet apparently on objects far away in space, because for them there exists no space" (p. 522). But how is the action of one soul upon another, as in thought-transferrence, suggestion, etc., to be accounted for? Dr. Raue devotes many pages to the discussion of this subject; but it seems to us that he gets lost in a cloud of words. Here is the essence of his doctrine, which the reader can judge for himself. "The nature of thought-transferrence consists essentially in the excitation of the modification in the recipient similar to the one excited in the agent, and is effected by mobile elements, and principally by primitive forces partially modified or charged with external stimuli. Void primitive forces determine the concentration of the mind to the modification which is to be transferred. The mobile elements (as all soul-forces are spaceless) do not move in the sense of corporeal forces from place to place: theirs is an attraction of like to like, independent of corporeal distances or interpositions" (p. 400). We cannot think that Dr. Raue has solved the problem of the occult phenomena; but there are things in his book, nevertheless, that will interest not only special students of this subject, but also general students of psychology.

Reports on Elementary Schools, 1852-1882. By MATTHEW ARNOLD. Ed. by Sir Francis Sandford. New York, Macmillan. 12°. $2.25.

WE have here the various reports that Mr. Arnold from time to time made as an inspector of schools. They are, of course, written in his usual excellent style, and contain many remarks of more than merely temporary and local interest. Every thing statistical or of transient importance is omitted, so that the matter presented relates entirely to the general principles of education, subjects of study, methods of teaching, and other topics in which educators everywhere are interested. Mr. Arnold's district at first comprised most of the midland counties of England and a large part of Wales, but schools controlled by the Anglican and Roman churches were not under his charge. At a later time he had the oversight of all classes of schools, but only in a small district consisting of Westminster and its neighborhood. Mr. Arnold was evidently not well impressed with the character of most of the schools, and he complains of the slow progress they made. He speaks of the low degree of mental culture prevailing not only in the lower schools, but also among candidates for the teachers' training-schools, all of whom were eighteen years old or over. This lack of general culture he attributes to the want of true literary training; and he affirms that all the literary culture the mass of English school-children get is the ability to read the newspapers,— a remark which, we fear, is applicable to other countries than England. He strongly recommends the study of English grammar and analysis, on the ground that "grammar is an exercise of the children's wits; all the rest of their work is in general but an exercise of their memory." Besides grammar, he would teach what the Germans call *Naturkunde,* or the leading facts and laws of nature, with geography and national history; this programme being intended for pupils not over thirteen years of age. He deprecates the evils that result from cramming for examination, some of which he predicted in advance. He seems to have had a keen eye for every thing connected with the schools, attending even to the form of the desks, the cleanliness of the rooms, etc. The book presents no theories of importance but such as readers of Mr. Arnold's other works are already familiar with; but it contains much that will be interesting to educators.

The Principles of Empirical, or Inductive, Logic. By JOHN VENN. New York, Macmillan. 8°. $4.50.

THIS work contains the substance of lectures which the author has been giving for some years past to his pupils at Cambridge University. It is a discussion rather than a treatise; and the reader must be already familiar with the rudiments of logic, both inductive and deductive, in order to understand it. It is mainly devoted to induction, though there is a chapter on the theory of the syllogism, and other chapters on weights and measures, the possibility of a universal language, and other topics not really belonging to logic. The principal fault of the book is a tendency to trifling distinctions and over-subtle refinements of thought. For instance, Mr. Venn calls attention to the fact that in some departments of investigation, especially in social affairs, our own acts have an influence on the phenomena we study; and he maintains that this is true in all departments. Even the astronomer, he says, by moving to and from his instrument and by the movements of his hand in making his calculations, alters the position of every body in the universe. Again, he inquires whether we can drop a stone twice in the same spot, and answers the question in the negative, because, even if we could hold the stone in exactly the same position the second time, and at the same height, the weight and temperature of the air would be altered, and, anyhow, the moon and stars would not be in the same position as before. The book contains a great number of these hair-splitting distinctions; and, though a few of them may have some scientific importance, the great mass are hardly more than curiosities of thought.

But, in spite of this tendency to over-subtlety, the book is an able one, and professional logicians in particular will find in it much food for thought. Mr. Venn's standpoint is essentially that of Mill; but he goes rather beyond Mill in maintaining the merely probable character of all truth obtained by induction, and he uses the term "empirical" in the title of his book for the purpose of emphasizing this view. His theory of causation is the same as Hume's; while as to the methods of induction he adopts the views of Mill with but little variation. As regards the syllogism, he differs from Mill, holding that it really gives us new knowledge. He has some interesting remarks on hypothetical and disjunctive propositions, and advances a theory of disjunctives that is, we believe, new; and, though we can hardly agree with it, it is well worthy of attention. In his concluding chapter, Mr. Venn discusses the logic of morality and the moral sciences, on which he has some important remarks. He calls attention to the fact that investigations in social matters, and especially predictions as to what will happen, are more or less vitiated by the fact that the course of events will depend in part on what the investigator himself may choose to do, and that in the case of men of genius this influence of the indi-

vidual counts for a great deal. Moreover, he makes the acute remark, that, even if we could succeed in predicting the actions of men, the mere publication of our predictions would probably lead them to act differently. The chapter on these subjects is one of the best in the book. With regard to the general character of induction and the principles on which it is founded, we are not in agreement with Mr. Venn, nor do we think that any one has yet given us the true theory; but we trust that no one who studies the subject will overlook this able work.

Home Gymnastics for the Well and the Sick. Ed. by E. Angerstein and G. Eckler. With many woodcuts and a figure-plate. From the 8th German ed. Boston and New York, Houghton, Mifflin, & Co. 8°. $1.50.

THIS book is intended, as its title implies, to instruct members of the home circle how to exercise in order to preserve health, or, if perchance they are sick, how to restore health in so far as any restoration is possible through the judicious use of exercise. Only such movements are described as can be made intelligible by descriptions and drawings, for the very object of the book is to enable one to do without a teacher. In the first division of the work the effect of bodily exercises, and rules for the practice of gymnastics, are given. After describing the beneficial effect of exercise on the muscular system, the author directs attention to its effect on the nervous system, a point which is apt to be overlooked. He truly says, that, of all parts of the organism, the nervous system occupies the first rank, inciting and guiding, at it does, all the performances of the body. A healthy nervous system is a fertile soil for the growth of a normal mental and spiritual life; and, while the use of gymnastics creates conditions which develop the nervous system, it has the power at the same time of exercising a wholesome effect on mind and spirit, and in many special cases of depression, hypochondria, and melancholia, may effect a cure. He further calls attention to the fact that the power of attention and of quick volition develops eventually into a capacity of quickly grasping new situations, and of quickly re-acting on given incitements; in other words, alertness, determination, and presence of mind are developed. The general rules for the practice of gymnastics are well chosen, concise, and practicable. In them the best time for taking exercise, the proper manner of dressing, and simple forms of apparatus, are described. In the second division the author considers gymnastic exercises at home, including movements of the head and neck; exercises for the trunk, arms and hands, legs and feet; walking, running, and jumping. The third division deals with the application of the exercises to healthy persons during babyhood, childhood, the school age, adolescence, maturity, and old age. The application of the exercises for invalids is thoroughly described, and those who have any physical trouble which can be remedied by judicious exercise will find specific directions for its employment. The book is well and sufficiently illustrated, and is by far the best work of the kind with which we are acquainted.

AMONG THE PUBLISHERS.

"THE Insane in Foreign Countries: An Examination of European Methods of Caring for the Insane," by the Hon. William P. Letchworth, president of the New York State Board of Charities, was recently published by G. P. Putnam's Sons, New York and London. To the physicians and managers connected with the institutions for the insane, and to all interested in the care and welfare of the mentally diseased, this book will prove serviceable and instructive. The introductory chapter comprises a brief historical survey of the treatment of the insane in various countries from the earliest times to the present day. Then follow chapters devoted to the lunacy systems of England, Scotland, and Ireland, and to representative institutions of these and continental countries; and a chapter each is given to the remarkable insane colony of Gheel and to the noted asylum at Alt-Scherbitz, near Leipzig, which latter illustrates the combined excellences of a colony and a hospital. The final and longest chapter presents a *résumé* of the author's observations, and his conclusions drawn from them. Based upon the results of his inspections of foreign and American asylums, and of his own experience in the supervision of the defective classes of New York State, Mr. Letchworth offers his views as regards the selection of sites and locations of asylums, the kind of buildings to be provided, the questions of sewage-disposal, water-supply, protection against fire, the laying-out of the grounds, the furnishing and decoration of wards and rooms, the difficult problem of the disposition of the acute, the chronic, and the criminal insane, the practice of restraint and the amount of liberty that may be granted, the character of the attendants to be chosen, the religious exercises, amusements, employments, dress and clothing, visitation and correspondence of patients, *post-mortem* examinations, the question of voluntary admission, the methods of admission and discharge, and the value of summer resorts. Besides these, the author gives his personal views respecting the insane in poorhouses, local or district care of the insane, State care, the boarding-out system, State supervision, and kindred topics. The book is beautifully printed, and richly illustrated with engravings and heliotype reproductions of plans of buildings and asylum interiors, and pictures of historical interest.

— Messrs. Longmans, Green, & Co. will shortly publish the life of C. B. Vignoles, an English civil engineer, who was assistant surveyor in South Carolina in 1817–20, and who surveyed and mapped Florida a little later. He aided Ericsson in building the "Novelty" as a rival to Stephenson's "Rocket," and he became one of the foremost of English railway engineers.

— Lord Randolph Churchill is one of the English politicians in whom Americans take an interest for various reasons. His speeches, collected, edited, and annotated by Mr. Louis J. Jennings, formerly of *The New York Times*, have just been published by Longmans. In his introduction, the editor sketches Lord Randolph's political career, and draws a piquant parallel with that of Lord Beaconsfield.

— Ginn & Co. announce in their Classics for Children Series "The Two Great Retreats of History," to be ready in May. This volume contains Grote's "History of the Retreat of the Ten Thousand Greeks from Babylonia," and an abridgment of Count Ségur's "History of the Retreat of Napoleon from Moscow." The two works stand in striking contrast to each other: one as the story of a great success; the other, of unexampled failure. Both are ably written, Ségur's having been translated into nearly every European language, and both convey important historical lessons to all who desire to know not only what man can do, but also what man can endure. Each narrative has an introduction, and is supplemented with a map and all needed footnotes. This firm also announces "Heroic Ballads and Poems" in preparation.

— The April number (No. 42) of the Riverside Literature Series (published monthly at 15 cents a number by Houghton, Mifflin, & Co., Boston) contains Emerson's "Fortune of the Republic," and other American essays. These essays, besides their literary merit, have an historic interest; and three of them were delivered in times of great political excitement, — "American Civilization," at Washington, in January, 1862, in the presence of President Lincoln, some months before the issuing of the Emancipation Proclamation; "The Emancipation Proclamation," in Boston, in September, 1862; and "Abraham Lincoln," at the funeral services consequent upon President Lincoln's assassination, held in Concord, April 19, 1865. Of the other two essays, "The Young American" was delivered in Boston in 1844, and "The Fortune of the Republic," in the Old South Church, in 1878.

— The May number of the *Magazine of American History* brings information of "Washington's Historic Luncheon in Elizabeth," with pictorial attractions, including a sketch of the Boudinot mansion, in which the luncheon took place; portraits not before published of some of Washington's contemporaries who were present; with engravings of pieces of the china table-service and silverware that were used. The same table-service, in perfect preservation, was placed before President Harrison at the luncheon given in his honor the day of his arrival in New York City, April 29, 1889. The second chapter of the number, "Oak Hill, the Home of President Monroe," is also from the pen of the editor, and

is illustrated. The third contribution, "Indiana's First Settlement," by the Hon. E. A. Bryan, president of Vincennes University, is on the beginnings of the State of Indiana, with portraits of George Rogers Clark and François Vigo. Then follows "The Harrisons in History," by Mrs. Ella B. Washington, an account of the President's family; "The Historic Quadrille," by Gen. John Cochrane, pointing out the historic idea which seems to have been so little understood by the public at large; "Reminiscences of Mrs. Bradford," the daughter of Hon. Elias Boudinot, who was one of the ladies of the Washington circle, by J. J. Boudinot; "Slavery in Connecticut," by Charles M. Andrews; and "Louisburg, 1745, Bunker Hill, 1775," by Nathan M. Hawkes.

— The *International Record of Charities and Correction* has been removed to Springfield, Ill., where the publishing details will hereafter be under the charge of the Rev. F. H. Wines, with whom the plan of the *Record* originated, and who has from the outset been its editor. The suspension of the *Record* for the last four months has been caused by the fact that it had not succeeded in securing sufficient support to return the cost of its publication, which has resulted in a considerable deficit, that has now been met by the voluntary contributions of its friends. The plan and the execution of the *Record* have been very warmly commended by the best authorities, and the successive numbers have been cordially welcomed by a certain circle of readers interested in the special subjects to which it was devoted; but the support for it, even on the part of those directly concerned in reformatory work, was much smaller than had been looked for by Mr. Wines and by those who had associated themselves with him in the undertaking. The valuable editorial services of Mr. Wines have been contributed entirely without compensation, and at no little personal sacrifice. Mr. Wines proposes to continue the publication at Springfield, which will enable him to deliver to the subscribers, at an early date, the numbers required to complete the current volume; and it is his hope to receive such further encouragement from the public as may warrant him in continuing the publication without further break, and may enable him to secure for the *Record* a permanent place as the recognized organ of the charity-reform interests of the country.

— The April issue of *The Trained Nurse* (consecrated to those who minister to the sick and suffering in hospital and home) contains articles on "The Relation of Hospitals to Medical Education," "Insanity, its Causes and Cure," "Articles for the Mother's Use," "Health in our Homes," "Asepsis for the Nurse," besides considerable other editorial and original matter. The monthly Hospital Supplement contains hospital news from all parts of the world. The Lakeside Publishing Co., Buffalo, N.Y., are the publishers.

— A. D. F. Randolph & Co. have ready an interesting literary contribution to the anniversary celebration, in Mr. Thomas E. V. Smith's volume, "The City of New York in the Year of Washington's Inauguration, 1789."

— Roberts Brothers have just ready "Ethical Religion," a volume of lectures delivered by W. M. Salter before the Society of Ethical Culture of Chicago; and a revised edition of C. E. Pascoe's useful handbook, "London of To-Day," which is now in its fifth year.

— Houghton, Mifflin, & Co. will publish shortly another contribution to the growing Emerson literature. The forthcoming volume is by the son of the sage of Concord, Mr. Edward W. Emerson, who will afford a glimpse into the domestic life of his father. The title of the book will be "Emerson in Concord." Houghton, Mifflin, & Co. have also under way an illustrated edition of Thackeray, which will be, it is promised, more complete than any other existing edition. It will be in twenty-two 12mo volumes printed in large type.

LETTERS TO THE EDITOR.

Magnetic Storms and their Astronomical Effects.

THE earth is sometimes spoken of as a great magnet. Its magnetic condition, however, is not constant, but varies within rather wide limits. Some of the changes are periodic, while others are spasmodic and irregular. The sunspot period appears to be in some way related to the changes in the earth's magnetic condition; for, at the time when the spots are at their maximum in number, the so-called magnetic storms are most frequent and violent. There is a general agreement among meteorologists that the magnetic changes observed upon the earth are in some obscure manner due to the influence of the sun.

In meteorology, as elsewhere, when other explanations are unavailable, resource is found in electricity, especially so if electrical phenomena can be in some manner discovered to be involved; and this happens to be the case in a very great number of phenomena, not as causes, but as effects. Not infrequently it happens that some of the best-known laws of electricity are ignored, or are confounded with other laws of other forms of energy. This seems to be precisely the case in this phenomenon.

In his article upon meteorology, in the last edition of the "Encyclopædia Britannica," Balfour Stewart says, "We are thus driven to look to the upper regions of the earth's atmosphere as the most probable seat of the solar influence in producing diurnal magnetic changes; and it need hardly be said that the only conceivable cause capable of operating in such regions must be an electric current. Now, we know from our study of the aurora that there are currents in such regions, continuous near the pole, and occasional in lower latitudes." And yet a little further on he argues very properly that more knowledge seems to be needed before we can assert that there are currents of electricity in regions where conduction is impossible.

Now, a current of electricity always implies conduction, and conduction implies molecular contact. We are abundantly able to prove this: for with such vacua as can readily be produced, say, the millionth of an atmosphere, not only will electricity not traverse it, but even Crookes's phenomena cease. At the height of a hundred miles, the average free path of the molecules is measured by feet; and this renders it as certain as any thing we know in physics, that electrical currents are impossible there, and hence, whatever may be the explanation of the magnetic changes in the earth, they are not due to currents of electricity in those high regions.

Still the earth is a magnet. It has its poles, though these change their position. The bulk of the earth with which we are acquainted is made up of non-magnetic matter, having varying degrees of conductivity; the rocky part being very poor, while the oceans and moist soils are conductors to such a degree as to permit commercial use for telegraphic and other purposes, thus saving the cost of a return conductor. The larger part of the surface of the earth is, then, an electrical conductor. Whenever a conductor of electricity is rotated in a magnetic field, an electrical current is the result; and such current is maintained so long as the rotation is continued, the strength of the current depending upon several variables, the strength of the magnetic field, the degree of conductivity, and the rate of rotation.

That electrical currents are continually traversing the crust of the earth, has been established, since the telephone has provided us with an instrument delicate enough for observation, and employed by so many all over the earth.

To be sure, it was known before that earth-currents were sometimes present, for upon occasions they were so strong as to interfere with or stop telegraphic communication. Such interruptions were generally coincident with auroral displays, but sometimes occurred in the day-time, when auroral effects could not be seen if they chanced to be present. As these earth-currents have been found to be coincident with both magnetic disturbances and with spasmodic solar action, — for several observers have noted solar eruptions at times when the magnetometers gave evidence of magnetic changes in the field, and in one or two cases even determining that the rate of transmission of the sun's action was the same as that of light, — it follows that the earth acts as if it were rotating in the magnetic field of the sun.

If the sun be considered as a magnet, then its field extends to an indefinite distance in space, and the earth must be rotating in it; and, so far as the earth is a conductor, there should be currents in it: in fact, just what we discover. So far, the electricity is an effect, and not a cause, magnetism being the preceding physical state.

A conductor moving in a magnetic field in such a manner as to have electrical currents generated in it always suffers retardation of its motion, as is illustrated by letting a coin fall between the poles of a strong magnet, — a property utilized in modern galvanometers to bring the needle quickly to rest. Such currents are technically known as "Foucault's currents," and the energy they represent is at once transformed into heat in the conductor. The electricity is but the transient state intermediate between the retarded motion and the rise in temperature. This series of physical relations — viz., the rotation of a conductor in a magnetic field, the retardation of the motion, the electrical current, and the final transformation into heat of original energy of the mechanical motion — is a well-ascertained series of effects, which is universal; and thus it follows, that, so far as the earth has currents of electricity set up in it by the sun's action, so far its rotary motion is retarded, and also its temperature is increased, both effects not hitherto recognized so far as I know. Of course, the retardation of motion is very small indeed, but it must be taking place, and in time will bring the earth to a standstill. What the amount may be, there appears to be no way of determining, because there is no way of ascertaining the strength of the earth's currents, nor the earth's resistance, nor the strength of the magnetic field of the sun.

Furthermore, the retardation of other bodies in the solar system may be traced to the same physical conditions instead of frictional resistance of the ether, which has sometimes been hypothecated.

Lastly, if the magnetic condition of the earth varies, it follows that the magnetic field of the earth varies, and all bodies in that field are re-acted upon by it. The gases of the atmosphere at high altitudes have free paths comparable with those in Crookes's tubes, and might fairly be expected to exhibit similar phenomena if electrified and in a changing magnetic field. Their electrification need not be much of an assumption, when one considers what happens in a thunder-shower. Rotating molecules, if conductors of electricity, ought to have Foucault's currents in them when in a magnetic field, and they should therefore be heated. As there is no chance for conduction of the heat, the rate of vibration increases till incandescence is reached. The only way in which the molecule can unload its extra energy is by radiation.

The motions seen in auroras may thus be due to the changes in the magnetic field of the earth instead of to electrical currents circulating in the high air.

A. E. DOLBEAR.

College Hill, Mass., April 23.

Chrome Yellow considered as a Poison.

THE object of this note is to spread wide the facts that chrome yellow is a poison, and that its use in food-stuffs is by no means rare.

The cases reported up to this time, in which toxic action is assigned to lead chromate and to chrome yellow, — bodies which apparently all writers consider as identical, — are many more than a hundred. Seemingly the first report is to be found in the *Medical Times and Gazette* of Dec. 24, 1859, in which are set forth the cases of six school-lads who were seriously poisoned by eating Bath buns. These latter were shown to contain each "seven grains of chromate of lead," which had been used as coloring-matter in lieu of eggs. All of the six lads are stated to have recovered.

In 1874, Von Linstow was next to assign toxic action to these bodies. He attributed to them the deaths of two children, within his own practice, who had eaten possibly seven artificial bees which had served to ornament a cake. Each of these bees had been colored by about four milligrams of "neutral lead chromate." The cause of death was destruction of the coats of the œsophagus and stomach, with puncturing of the intestines. The cases are reported in Eulenberg's *Vierteljahrsschrift f. ger. Med.*, N.F. XX., and

are mentioned as being a part of the literature of the subject. They are entirely discredited by the later work of Stewart, of Marshall, and of others, all of which will be mentioned later.

In 1882, R. C. Smith printed an account of more than fifty cases of poisoning among English mill-operatives who had breathed the dust of lead chromate given off from yellow dyed yarn in process of manufacture. The cases occurred in his own practice and in that of his co-workers, and authentication is complete. The effect was chronic lead-poisoning, clearly developed. This account, so important and interesting, is but a brief statement of bare fact. It is to be found in the *British Medical Journal*, 1882.

Five years before the publication of Dr. Smith's paper, Leopold (*Vierteljahrsschrift f. ger. Med.*, N.F. XXVII. 29) published an account of a babe which he stated had died from breathing lead-chromate dust from yellow dyed yarn. The cause of death is assigned to softening and perforation of the coats of the stomach, — an opinion to which Leopold, apparently, was bent by the cases of Von Linstow, already cited. As we now know quite surely that lead chromate is not at all a corrosive poison, we must so far discredit Leopold's case. In the same account he states that four adults who breathed the same dust incurred chronic lead-poisoning. He was therefore first to trace that kind of effect to the breathing of lead-chromate dust, and for that work we cannot offer him too much thanks.

The report of Smith is followed chronologically by the admirable work of Dr. D. D. Stewart of Philadelphia, the early history of which is to be found in the Philadelphia daily papers of July, 1887, and in the office of the coroner of that city. A few months previously, Dr. Stewart had found some cases of lead-poisoning, which, through tenacity of purpose, he finally traced to bakers' stuffs as the cause. He secured in a bakery the chrome yellow with which these stuffs had been colored, and showed that the baker himself was a physical wreck from eating his own wares; and, moreover, that several members of his family had died of lead-poisoning, brought about by eating the chrome-yellow colored stuffs. This latter was proven by the bodies exhumed by the coroner, who investigated altogether fifteen deaths. The work was done by Deputy Coroner Powers, who, in an interview at his office on Sept. 10, 1887, told the writer that it was a small estimate to put at two hundred the people in Philadelphia who had died of lead-poisoning induced by bakers' stuffs. The causes of death, he said, had been certified to various diseases, among them malaria and cerebro-spinal meningitis, but that now all physicians agreed that they were cases of lead-poisoning.

One who had examined the mortuary records informed the writer that others of these deaths were assigned to typhoid, typhus, epilepsy, Bright's disease, and to lepto meningitis. The real causes were established by Dr. Henry Leffmann, who analyzed the viscera of the exhumed bodies. The victims had died of lead-poisoning. During the coroner's investigations, it was shown that the use of chrome yellow by bakers as a coloring-matter was quite common. At an inquest held July 11, 1887, the evidence of Dr. Miller of the firm of Aschenbach & Miller, dealers in colors, was "that he believed that eighty per cent of the bakers in the city" used chrome yellow in certain of their bread-stuffs. In February of the following year, two of these bakers were sentenced to terms of imprisonment. The courts appear to have been lenient because the bakers themselves had been so distressed by the poisoning. One of them had lost a wife and five children, and was himself a wreck.

The discovery of the cause of so much suffering and death in Philadelphia is due to Stewart alone; and no less to him is due the action taken by the officers of the law towards the victims and the criminals.

The clinical history of Dr. Stewart's cases may be found in the *Medical News* of three dates: 1. June 1887, under the title "Notes on Some Obscure Cases of Poisoning by Lead Chromate;" 2. Dec. 31, 1887, "Clinical Analysis of Sixty-four Cases of Poisoning by Lead Chromate (Chrome Yellow) used as a Cake-Dye;" 3. Jan. 26, 1889, "Poisoning by Chrome-Yellow used as a Cake-Dye: A Subsequent Clinical History, etc." The literature of the subject has nothing at all comparable with these papers. In this field the author stands easily first among his brothers.

The chemical and pathological sides of the subject have lately been worked out, with painstaking and in the scientific spirit, by John Marshall, M.D., of Philadelphia. His paper is to be found in the *Therapeutic Gazette* for Feb. 15 of the present year. His experiments were made upon dogs, to which he fed pure lead chromate in various quantities, up to eighty-four grams. Careful analyses were made of the products of decomposition going on in the living animals, and finally autopsies were performed upon their bodies. The experimenter found that lead chromate had been decomposed in the bodies of the living animals, and that lead and chromium had been absorbed, and that in all cases "the stomach showed no evidence of corrosion." This work of Dr. Marshall is altogether excellent. No epitome of it could do it justice, and of course the workers in this field will read the original paper. It is proof positive that lead chromate could have produced all the effects which Stewart insists it did produce, in his cases.

The work so well done by Marshall suggested itself to the present writer at the time of the newspaper publication of Stewart's cases, and dogs were selected for the experiments. But it was put a stop to by two discoveries: (1) that the writer did not possess the knowledge requisite, and (2) that chrome yellow of commerce was not lead chromate. This latter discovery arose out of the analyses of various samples from many manufacturers, a few of the results being as follows: —

No. of Sample.	Lead Chromate.	Lead Sulphate.	White Lead.	
1	66.38	28.83	x	
2	32.52	18.82	47.04	
3	60.77	11.90	24.38	Samples analyzed as received, and no account taken of moisture.
4	14.47	20.81	60.95	
5	58.10	36.24	x	
6	26.79	68.84	x	

No. 1 was obtained in open market, and bore the name of distinguished manufacturers. It was marked "Pure Precipitated."

No. 2 was given the writer by Dr. Henry Leffmann, before mentioned. It was part of a sample submitted by the coroner of Philadelphia to his jury sitting upon one of the poisoning cases unearthed by Stewart.

Nos. 3, 5, and 6 were from a manufacturing chemist in Baltimore who wanted pure lead chromate, and who undertook to obtain it from among his correspondents. These three samples were certified as perfectly pure.

No. 4 was given the writer by Dr. Miller, from out of the stock of Messrs. Aschenbach & Miller, who as merchants were concerned in the Philadelphia chrome-yellow cases. It was kindly submitted as being of the kind used by the bakers concerned in Stewart's cases.

The samples given in the above table are selected as being typical of good commercial chrome yellow. Efforts continued through nearly a year did not result in finding a single sample of lead chromate sold as chrome yellow.

Having ascertained that commercial chrome yellow consisted of lead chromate with lead sulphate, and with white lead frequently, it followed that such a compound could produce lead-poisoning, and certainly would if taken into the stomach during any length of time. There could not exist, therefore, any doubt as to the correctness of the views of Stewart, so far as concerned the source of poisoning.

Shortly after newspaper publication of the Philadelphia cases, the writer bought and examined in Baltimore several samples of yellowish bakers' stuffs. None of them contained lead. But there was no such result with certain kinds of candy. There was to be had in two of the Baltimore public markets an abundance of candy made from glucose, and colored by chrome yellow. With the view of stopping its sale, one of the city papers agreed to collect candy samples by means of its reporters, and cause them to be analyzed. This was done, and on the first day of search five samples were bought in two of the markets. Four of the five contained chrome yellow in quantity from 0.199 per cent to 0.319 per

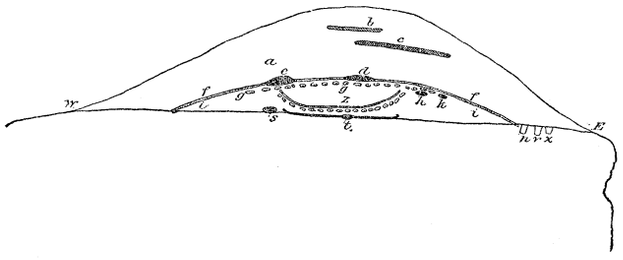
cent. The analyses are to be found in the *Baltimore American* of April 22, 1888, and are signed by the writer and his co-worker, Dr. William Simon. Both of us had repeatedly bought in the markets, and together had analyzed, similar candy with the same results. The quantity sold in a market on a market-day apparently was not less than ten nor more than thirty pounds. We have preserved samples of the material, and shall be glad to divide them with workers in this field. Such candy, consumed in such quantities, cannot have failed to produce in Baltimore an abundance of lead-poisoning.

From all this we deduce the following conclusions: that lead hromate breathed as dust, or taken into the digestive apparatus, produces lead-poisoning; that commercial chrome yellow ingested with food-stuffs produces more quickly the same result; that chrome yellow is a mixture of lead chromate and lead sulphate, to which frequently is added white lead ($2\ Pb\ CO_3 + Pb\ H_2O_2$); that none of these substances are corrosive poisons; that bakers' and confectioners' products not infrequently are colored with chrome yellow, and often are sources of lead-poisoning, which may exist largely in a community and yet escape detection. WM. GLENN.

Baltimore, April 26.

A Mound in Calhoun County, Ill.

MR. MIDDLETON, one of the assistants of the Bureau of Ethnology, has recently excavated quite a number of mounds in Calhoun County, Ill., among them one presenting some features of special interest. The following description is taken from Mr. Middleton's field-notes.



This mound, which forms one of a group of five located on the spur of a bluff about one hundred and fifty feet high, overlooking the Illinois River, stands at the brink of a precipice. It is conical in form, and ninety-five feet in diameter at the base.

As the internal structure is the most interesting feature, a figure is given showing a vertical section, in which $W-E$ indicates the line of the natural surface of the bluff, as well as the direction of the section.

"From the top downward to the depth of fourteen feet," says Mr. Middleton, "we passed through a layer composed chiefly of yellow clay (*a*) obtained from the surrounding surface of the bluff. Near the centre, at the depth of four feet, was a horizontal bed (*b*) of hard gray earth, — apparently muck from the river, — eight inches thick, and covering an area about twenty feet in diameter. Three feet lower was a bed (*c*) of burnt clay about the same thickness and extent as the preceding. Although particles of charcoal were mixed through it, no ashes were observed on or about it.

"At the depth of fourteen feet we reached what seems to have been the nucleus or original mound, over which the heavy mass of clay had been cast at some subsequent period. Over this lay a thin covering of whitish material (*f, f*), apparently light ashes, not more than two inches thick, and extending on all sides to the original base. This rested, for the most part, on a single layer of stones (*g, g*), the latter lacking several feet of extending to the outer margin. Examining carefully the stones which formed this layer, evidences of weathering on the upper side were distinctly visible, showing that the mound must have remained undisturbed at this height for a considerable length of time. The thin stratum of ashes over it seems to confirm this view, as the charred stems of grass near the outer margin show that this was produced by burning a covering of grass which had grown over it. The dark spots (*d* and *e*) indicate two small fire-beds resting on the layer of stones.

"Removing the stones, and cutting a trench through the low, broad, original mound or nucleus to the natural surface of the bluff, we found the construction to be as shown in the figure, — an oval basin (*z*), ten by thirteen feet in extent and three feet deep, lined throughout with a layer of stones similar to those above. It was filled with the yellow surface soil of the ridge. The stones, which bore very distinct marks of weathering, were covered with a thin layer of white ashes mixed with charred leaves and grass. Under the stones, and resting on the natural surface of the ridge, was a thin layer of decayed vegetable matter. The slopes ($i-i$) surrounding the basin were of yellow clay similar to that of the thick upper layer of the mound. The dark spots (*h* and *k*) are small fire-beds.

"Partly under and partly in the bottom layer of decayed vegetable matter, and exactly in the centre of the mound, was a single skeleton (*l*) lying on the back at full length, the feet to the south; but the head was wanting. Not a tooth, or particle of the jaw or skull, was to be found, though careful search was made. As all the other bones were well preserved and comparatively sound, except that the pelvis and some of the ribs were broken, I presume the head must have been removed before burial. This is the second instance I have observed in which the head was removed before burial. The first was dug up at Pecan Point, Arkansas.

"Six feet south of the centre of the mound was a small deposit of burned bones (*s*), lying on the natural surface of the bluff. Seven feet west of the centre, lying on the original soil, were the remains of an infant. It had been doubled up until the knees touched the chin, wrapped in a grass covering, and placed upon its left side.

"A shell-shaped vessel at the right shoulder of the large skeleton, and a shell, were the only specimens found in the mound. The latter was in a stone box or cist two feet and a half square and one foot deep, resting on the natural surface of the ridge. Not a fragment of bone was found in this box.

"Another singular feature observed consisted of three small pits (*n, v, x*) under the eastern base of the upper layer. These were three holes, from fifteen to eighteen inches in diameter, and one foot deep. One of them contained particles of rotten wood. There were several intrusive burials in the thick upper clay layer, which presented nothing of special interest."

It is apparent, from Mr. Middleton's figure and description, that we have in this tumulus a specimen of the Ohio "altar-mound" type, possibly a prototype. What he calls the nucleus or original mound is beyond question one of the so-called "altars" of the type described by Messrs. Squier and Davis, and is one more item of evidence that the Ohio mound-builders came from the West, as I have contended elsewhere. CYRUS THOMAS.

Washington, D.C., April 23.

New Sources of Heat.

IF, as I take it, the communication of your correspondent "X," on p. 329 of your issue of April 26, is intended as a sort of exposure, it is to be warmly welcomed.

What Mr. Blodget has actually done, I cannot say; but that his assertions are extremely inaccurate, I know. He states that "in all cases where a powerful blast is applied to the limited area of a melting-furnace . . . the degree of heat generated is greatly in excess of the theoretical yield of the number of pounds of coal consumed." This is absolutely untrue. On the contrary, measurements of the heat actually developed under these conditions agree surprisingly closely with the "theoretical yield of the number of pounds of coal consumed." This is well exemplified in Bell's calculations and measurements of the heat developed in the blast-furnace.

Mr. Blodget's statement that this excess of heat generated over the theoretical yield of the coal is particularly great in the Bessemer converter, is a case of astonishing ignorance, or, as I prefer to believe, of extreme carelessness in the use of words. I supposed that every reader of *Science* knew that no carbonaceous fuel was burned in the Bessemer converter (except, of course, in heating the converter between operations). A new Keely motor seems to be born. *Caveat emptor*. HENRY M. HOWE.

Boston, April 29.

INDUSTRIAL NOTES.

THE Thomson-Houston Company has been obliged to greatly increase their facilities in order to handle their rapidly increasing business in electric railways. In addition to the large contracts which they closed some time ago, they have lately closed the following: Lynn and Boston Railroad Company, Nahant Line, which has 4,300 feet of track, two turnouts, maximum gradient of four per cent, the line extending from Central Square, Lynn, to Nahant House, Nahant: one car will be put in operation at first, the power for which will be obtained from the station of the Lynn Electric Light Company. Newburyport and Amesbury Horse Railway Company, Newburyport, Mass., which line is about six miles in length, and will operate two cars: it is made up almost entirely of curves and grades, the maximum of which is ten per cent; the cars will be operated by a current from the Newburyport Electric Light Company, Newburyport, Mass., and also from the Amesbury Electric Light Company, Amesbury, Mass. The Newton Circuit Line, Newton, Mass., which will operate ten cars, and is eight miles in length: it will run from Newton to Watertown on the West End track, and on new track from Watertown to West Newton and Newtonville. The Plymouth and Kingston Railway Company, Plymouth, Mass., which line is four miles in length, and will operate three cars, the maximum gradient being six per cent: this line will run from Chiltonville, through Plymouth, to Kingston, and on nearly all of the line the bracket method will be used; the track is about laid. The Quincy Street Railway, Quincy, Mass., which line will operate four cars, and is five miles in length, extending from Quincy, through Wollaston Heights and Atlantic, to the Neponset River; the bracket method of overhead construction will be used. The company has also received orders for new cars from the Wheeling Railway Company, Wheeling, W.Va.; West End Street Railway Company, Boston, Mass.; Topeka Rapid Transit Company, Topeka, Kan.; Omaha and Council Bluffs Railway and Bridge Company, Omaha, Neb.; Lynn and Boston Street Railway Company, Lynn, Mass. The company has also constructed a track of about one mile for the Hillside Coal Company of Scranton, Penn., on which a forty-horse-power locomotive is used. This is used for carrying coal, and is capable of hauling about twenty cars loaded with one ton each.

— The Thomson-Houston Electric Company report the following sales of stationary motors: 7.5 horse-power, Walker & Pratt Manufacturing Company, Boston, Mass.; 1 horse-power, J. R. Kelly, Providence, R.I.; 10 horse-power, Georgia Electric Light Company, Atlanta, Ga.; 10 horse-power, Master-Builders' Association, Boston, Mass.; 1 horse-power, A. Harris, Providence, R.I.; 1.5 horse-power, Bonschur & Holmes, Philadelphia, Penn.; 3 horse-power, H. W. Ladd, Providence, R.I.; 1.5 horse-power, W. Shedley, Providence, R.I.; 10 horse-power, J. J. Hillman, Boston, Mass.; 15 horse-power, Garfield & Proctor Coal Company, Boston, Mass.; 1 horse-power, Cambridge Shirt Company, Cambridgeport, Mass.; 1.5 horse-power, A. C. Manchester, Providence, R.I.; 1.5 horse-power, New Bedford Gas Company, New Bedford, Mass.; 3 horse-power, C. F. Heptonstall, Providence, R.I.; 1 horse-power, B. F. Haley, Dover, N.H.; 1.5 horse-power, John M. Sweeney, Wheeling, W.Va.; 3 horse-power, B. L. P. Martin, Providence, R.I.; 5 horse-power, T. C. Entwistle, Lowell, Mass.; 15 horse-power, Minot Estate, 30 Court Street, Boston, Mass.; 20 horse-power, Whittier Machine Company, Boston, two motors for elevators; 5 horse power, Thomson-Houston Electric Light and Power Company, Buffalo, N.Y.; 10 horse-power, Wales Manufacturing Company, Syracuse, N.Y.; 5 horse-power, St. Catherines Electric Railway Company, St. Catherines, Ont.

— The Thomson-Houston Electric Company reports the following sales of arc and incandescent lamps; Adams, Mass., 45 arc; Falls City Jean and Woollen Mill, Louisville, Ky., 200 incandescent; Sanford Woollen Mills, Medway, Mass., 100 incandescent; Stearn & Silverman, Wheeling, W.Va., 20 arc; Monroe County Insane Asylum, Rochester, N.Y., 600 incandescent; Moore Building, Syracuse, N.Y., 200 incandescent; Saxon Woollen Mills, Franklin, Mass., 200 incandescent; New Haven, Conn., 45 arc; New England Company, Bath, Me., 300 incandescent; Washington Court-House, O., 50 arc; Buffalo, N.Y., 190 arc; Cambridge, Mass., 1,000 alternating; Lowell, Mass., 1,000 alternating; Hudson River Street Hospital, Poughkeepsie, N. Y., 800 incandescent; Leominster, Mass., 50 arc, 600 alternating; Bedford, Penn., 50 arc, 600 alternating; Leicester, Mass., 600 alternating; Stamford, Conn., 1,500 alternating; Hudson, N.Y., 45 arc; Fernandina, Fla., 50 arc; Portland, Me., 45 arc; New Decatur, Ala., 50 arc; Manchester, N.H., 100 arc; Chester, Penn., 30 arc; Revere, Mass., 600 alternating; H. W. Smith, Bangor, Me., 50 incandescent; Findlay, O., 1,000 alternating; T. J. Stewart, Milo, Me., 50 incandescent; Woonsocket, R. I., 1,000 alternating; Riverside and Oswego Mills, Providence, R.I., 400 incandescent; Pitman, Mass., 500 alternating, 50 arc; Morse Whyte, Cambridge, Mass., 200 incandescent; Rockland, Me., 30 arc; Jewell Milling Company, Brooklyn, N.Y., 200 incandescent; Savannah, Ga., 250 arc; James Walker & Co., Basin Mill, Mo., 50 incandescent; Malden, Mass., 500 alternating; Fort Paine Coal and Iron Company, Fort Paine, Ala., 400 incandescent; Upper Sandusky, O., 60 arc; J. B. Mason, Providence, R.I., 50 incandescent; Columbus, Ga., 1,000 alternating, 100 arc; Thomasville, Ga., 50 arc; Perry Paine Building, Cleveland, O., 1,000 incandescent.

Publications received at Editor's Office, April 15-27.

ARNOLD, M. Reports on Elementary Schools, 1852-82. Ed. by Sir Francis Sandford. London and New York, Macmillan. 302 p. 12°. $2.25.

BOYLSTON, P. John Charáxes: A Tale of the Civil War in America. Philadelphia, Lippincott. 289 p. 12°. $1.25.

CLAUS, C. Elementary Text-Book of Zoölogy. Tr. and ed. by Adam Sedgwick and F. G. Heathcote. 2d ed. Vols. I and II. London and New York, Macmillan. 967 p. 8°. $8.

CONNOLLY, J. H. A Storm Ashore. Chicago, New York, and San Francisco, Belford, Clarke, & Co. 92 p. 12°.

CONVERS, D. Marriage and Divorce in the United States: As they are and as they ought to be. Philadelphia, Lippincott. 266 p. 16°. $1.25.

HILDRETH, C. L. The Masque of Death, and Other Poems. Chicago, New York, and San Francisco, Belford, Clarke, & Co. 168 p. 12°.

JACOBI, M. P. Physiological Notes on Primary Education and the Study of Language New York and London, Putnam. 120 p. 12°. $1.

KINKEAD, A. The Queen of the Block. Chicago, New York, and San Francisco, Belford, Clarke, & Co. 57 p. 12°.

LOGAN, C. Her Strange Fate. New York, Chicago, and San Francisco, Belford, Clarke, & Co. 268 p. 12°. 50 cents.

MELDOLA, R. The Chemistry of Photography. (Nature Series.) London and New York, Macmillan. 382 p. 12°. $2.

MONTGOMERY, D. H. The Leading Facts of French History. Boston, Ginn. 321 p. 12°. $1.25.

NICHOL, J. Francis Bacon, his Life and Philosophy. Part II. Bacon's Philosophy. Philadelphia, Lippincott. 259 p. 16°. $1.25.

PHIN, J. A Practical Guide to Success in the Use of Recipes, Formulæ, etc., Technological and Commercial. New York, Industrial Publ. Co. 44 p. 16°.

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